SELF-REGULATION AND MATH ATTITUDES: EFFECTS ON ACADEMIC PERFORMANCE IN DEVELOPMENTAL MATH COURSES AT A COMMUNITY COLLEGE

BY

CYNTHIA D. OTTS

Submitted to the graduate degree program in Educational Leadership and Policy Studies and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Education.

____
Chairperson

____

____

____

____
Committee members

Date Defended: ________________________________

The Dissertation Committee for Cynthia D. Otts
certifies that this is the approved version of the following dissertation:

SELF-REGULATION AND MATH ATTITUDES: EFFECTS ON ACADEMIC PERFORMANCE IN DEVELOPMENTAL MATH COURSES AT A COMMUNITY COLLEGE

Chairperson, Dr. Lisa Wolf-Wendel

Date approved:

Abstract

The purpose of the study was to investigate the relationship among math attitudes, self-regulated learning, and course outcomes in developmental math. Math attitudes involved perceived usefulness of math and math anxiety. Self-regulated learning represented the ability of students to control cognitive, metacognitive, and behavioral aspects of learning. The sample consisted of 376 students who were enrolled in developmental math courses at a community college. Although participants perceived math as fairly relevant to their lives, they did not experience much math anxiety. Participants were somewhat likely to engage in self-regulated learning, but the rates were not particularly high. Of the five self-regulated learning scales (metacognitive self-regulation, effort regulation, environmental management, peer help, and study strategies), students were most likely to regulate their effort and structure their learning environment. Findings from independent samples t-tests, one-way analyses of variance, and correlation analyses highlighted differences in math attitudes, self-regulated learning, and math outcomes based on demographic variables. First generation and part-time college students and students with dependents perceived math as more useful than their counterparts. Continuing generation and part-time students experienced higher levels of math anxiety than first generation and full-time students. Students who were female, non-traditional aged, married or divorced/separated, and those who had dependents were more likely to engage in self-regulatory strategies than their peers. Multiple regression analyses were conducted to determine a) the influence of math attitudes on self-regulated learning and b) the influence of self-regulated learning on final course grades in developmental math. Results indicated that attitudes toward math significantly predicted self-regulated learning and that self-regulated learning significantly predicted final course grades. Students who used self-regulatory strategies earned higher grades in developmental math courses. The results have implications for educational policy and practice. Developmental education programs should include instruction on self-regulatory strategies and should consider supplementing cognitive assessment measures with non-cognitive factors in order to better predict readiness for college coursework and academic potential.

Acknowledgements

Without the help, support, and encouragement of advisors, family, friends, and colleagues, this project would not have been possible. I am very appreciative of the guidance, feedback, and encouragement provided by my dissertation chair, Dr. Lisa Wolf-Wendel. I would also like to thank Dr. Dongbin Kim, for her assistance with helping define and refine the study, and the other members of the dissertation committee: Dr. Susan Twombly, Dr. Charles Carlsen, and Dr. Susan Gay. My sincere appreciation goes to the students, faculty, and staff at the community college who participated in the study. I would like to thank Lori Winningham, Dean of Behavioral Science, Math, Science, and Physical Education, for her permission to conduct the study at cooperating community college, and the participating faculty for allowing their students to participate. In particular, I would like to thank Bethany Chandler, the faculty liaison who coordinated research efforts at the community college, assisted in disseminating and collecting the survey instruments, and introduced me to other faculty and staff who assisted with the process. Ms. Chandler's positive attitude and eagerness to help were sources of strength. Esam Mohammad & Dr. Gene George, from the College's Institutional Research office, were instrumental in collecting data for the study. I would also like to express my thankfulness to Dr. Elizabeth Fennema and Dr. William McKeachie for their permission to use their survey instruments. Finally, I would like to thank my family and friends for their support. My parents, Bill and Joy Otts, instilled in me the importance of education. Their love and prayers have sustained me throughout the years. They have provided substantial support, encouragement, and resources that have enabled me to complete this project. My mother was one of my greatest supporters, and my biggest disappointment is that she did not live long enough to see its culmination. She remains a constant source of motivation, strength, and determination.

Table of Contents

List of Tables

Self-Regulation and Math Attitudes: Effects on Academic Performance in Developmental Math Courses at a Community College

More and more students are entering college academically underprepared (ACT, 2008; McCabe, 2000; Venezia, Kirst, & Antonio, 2004). Underprepared students, also commonly referred to as remedial or developmental students are those who lack college-level skills in subjects such as English and mathematics (Cohen & Brawer, 2003; Garavalia & Ray, 2003). The lack of adequate academic preparation stems from the lack of curricular coordination between high schools and postsecondary institutions and the rigor of the students' high school curriculum (Adelman, 1999; Hoyt & Sorensen, 2001; Venezia et al., 2004). High school graduation requirements do not align with college entrance requirements, often resulting in a gap between what high school graduates know and what college-bound students need to know to be sufficiently prepared for college (Venezia, et al., 2004). High school preparation is significantly related to academic underpreparedness (Hoyt & Sorensen, 2001). First generation, low income, and ethnic minorities are more likely than their counterparts to be underprepared (McCabe, 2000; Wirt, Choy, Rooney, Provasnik, Sen, & Tobin, 2004) and are less likely to have access to college preparatory courses in high school and to perform well on college entrance exams (Venezia et al., 2004; Hearn & Holdsworth, 2004).

McCabe (2000) suggests that the goal of secondary education should be to adequately equip at least 80% of high school graduates for college; however, he reports that only 42% of high school graduates are college-ready. A more recent report by ACT (2008) indicates that less than one quarter of college-bound high school students who took the ACT were adequately prepared for college. Thirty two percent of those who tested lacked adequate preparation in English while nearly half, 47%, lacked skills in reading comprehension (ACT, 2008). The results were even more dismal in math and science, where 57% and 72% of students, respectively, tested below college level (ACT, 2008).

Whatever the reasons for students' inadequate academic preparation, underprepared students are finding their way to college campuses. Annually, more than one million students who enter higher education are not college-ready (McCabe, 2000). Postsecondary institutions have responded by establishing developmental or remedial programs, courses and academic assistance programs that are designed to enhance basic skills (Boylan, 2002; Casazza & Silverman, 1996; Cohen & Brawer, 2003). The purpose of developmental education (which is generally the preferred term because it posits a strengths-based approach) is to prepare students for college level courses through skill enhancement and the development of study skills and habits that lead to academic success (NCDE, 2008; Provasnik and Planty, 2008).

Developmental courses generally do not apply toward degree requirements, but students are encouraged or mandated to enroll in them as a result of low college entrance exam or placement scores (Cohen & Brawer, 2003). A report by the National Center for Education Statistics (NCES) indicates that 29% of students who attended public, community colleges and 19% of students who attended public, four year institutions in 2003-04 enrolled in at least one developmental course; however, the authors caution that the figures, which are based only on freshmen and are self-reported, are on the low end of enrollment estimates for developmental education (Provasnik and Planty, 2008). Data from other sources report higher figures. For example, a 2003 NCES report revealed that in fall 2000, 28% of entering freshmen nationwide (approximately 670,880 students) took at least one developmental course (NCES, 2003). Twenty percent of freshmen (approximately 169,800) who attended public, four-year institutions enrolled in at least one developmental course in fall 2000, compared to 42% of those (approximately 416,640 students) who attended public, two-year colleges (Livingston & Wirt, 2004; NCES, 2003). About 60% of community college students and three-quarters of Black and Hispanic community college students who participated in the National Education Longitudinal Study of 1988 enrolled in at least one developmental course their first year (Bailey, Jenkins, & Leinbach, 2005).

While the problem of academic underpreparedness is widespread, it is most pervasive in math (Boylan & Saxon, 1999; Provasnik & Planty, 2008). McCabe (2000) describes math as the "greatest hurdle" for developmental students to overcome (p. 40). Nationwide, over 60% of underprepared students attending community colleges are deficient in math, 38% are deficient in reading, and 45% are deficient in writing (McCabe, 2000). To meet the demand for math remediation, most institutions offer developmental math courses (NCES, 2003). Ninety-seven percent of public, two-year colleges and 71% of two- and four-year institutions offered developmental math courses in fall 2000 (NCES, 2003). Most institutions offer multiple levels of developmental math courses, with 60% offering three or more levels (Boylan & Saxon, 1999; NCES, 2003).

Enrollment in developmental math exceeds enrollment in other developmental courses nationwide (Boylan & Saxon, 1999; NCES, 2003). At public, two-year colleges, 35% of students took developmental courses in math, compared to 23% in writing and 20% in reading (Livingston & Wirt, 2004). In fall 2000, 22% of students nationwide required remediation in math, compared to 14% in writing and 11% in reading (Livingston & Wirt, 2004). NCES (2003) estimates that in fall 2000, over 525,000 freshmen nationwide were enrolled in developmental math courses, compared to 335,440 in writing and 263,560 in reading. Well over half of those freshmen, approximately 347,000, were enrolled in developmental math at two year colleges (NCES, 2003).

Although college math is generally a requirement for degree completion, many students struggle with developmental and college-level math courses, which may prevent them from accomplishing their educational or career goals (Adelman, 2004). High withdrawal and failure rates are characteristic of developmental math courses, with rates hovering around 20% and 30%, respectively, based on a sample of community college developmental education students (Gerlaugh, Thompson, Boylan, & Davis, 2007). Based on postsecondary transcript analyses of 1992 high school seniors who participated in the National Education Longitudinal Study of 1988 (NELS: 88/2000), Adelman (2004) found that developmental math courses had the highest percentages of withdrawal and repeat rates (ranging from 21-29%), as well as failure rates (14%) of all college courses nationwide (Adelman, 2004).

Drew (1996) suggests that "…math may be the single most important factor related to an individual's success in college and beyond" (p. 9). Math is a subject that is needed for entry into many careers and is imperative for both existing and emerging occupations in a global, information- and technology-based economy (Bureau of Labor Statistics, 2008; Drew, 1996). Math is not only necessary for daily skills such as managing money, but also for employment in some of the most lucrative occupations (Saffer, 1999). Millions of jobs require some mathematical skills (Saffer, 1999). Mathematical concepts such as "normal distribution" and "exponential growth" are common vocabulary in many fields including business and social sciences (Tobias, 1990). Therefore, it is important that students have a basic understanding of math and are able to apply math principles to their daily lives and work. Drew (1996) argues that there is an assumption within the U. S. culture that only a small percentage of students have math ability; however, he insists that the assumption is incorrect. He blames that mistaken assumption for the fact that the U. S. is failing to adequately prepare students to participate in today's global economy (Drew, 1996). He argues that raising expectations concerning math performance is the most important step to improve math achievement in the United States (Drew, 1996).

In general, underprepared students are at high risk for attrition and academic failure (Garavalia & Ray, 2003). Developmental students are among the lowest achieving college students, not only because they lack basic skills, but perhaps because they also lack the sustained effort and motivation necessary for long-term academic tasks (Bembenutty & Zimmerman, 2003; Garavalia & Ray, 2003). Such students have a tendency to give up when faced with difficult academic tasks or non-academic distractions or stressors (Bembenutty & Zimmerman, 2003). However, students who are self-regulated learners c\are capable of persevering throughout the learning process (Zimmerman, 1998) because they are better able to control cognitive, metacognitive, and behavioral aspects of learning (Pintrich, 1995; Zimmerman 1990, 1998; Zimmerman & Bandura, 1994; Zimmerman & Martinez-Pons, 1988). The influence of self-directed learning on developmental math outcomes is unknown, so this study examines that relationship.

It is likely that self-directed learning and attitudes toward learning and the subject matter affect the learning process. Mealey (1990) suggests that negative attitudes may undermine the learning process of developmental students. Negative attitudes toward math have long been hypothesized to influence the learning of math (Bassarear, 1986; Chouinard, Karsenti, & Roy, 2007; Fennema & Sherman, 1976; Gourgey, 1984; Ikegulu, 2000; Kincaid & Austin-Martin, 1981; Ma, 1997; McLeod, 1994; Middleton & Midgley, 1997; Stipek, Salmon, Givvin, &

Kazemi, 1998; Updegraff & Eccles, 1996). Attitudes toward the subject matter may relate to self-regulated learning, a measure of one's ability to control the learning process. This study examines the relationship between math attitudes and self-regulated learning. It also investigates the influence of math attitudes and self-regulated learning on developmental math course outcomes.

Purpose of the Study & Research Questions

Because a large portion of college students need remediation in mathematics and many students do not successfully complete developmental math courses, it is important to ascertain factors other than ability that influence achievement in developmental math courses. Tittle and Hecht (1992) describe the relationship among self-regulation and attitudinal factors as an area that has received little classroom-based research attention. Such research is important because self-directed learning and attitudes toward learning may influence the academic performance of underprepared students (Bassarear, 1986; Gerlaugh et al., 2007; Saxon & Boylan, 1999).

The purpose of this study is to examine whether self-regulated learning and attitudes toward math influence developmental math course outcomes among community college students. Specifically, the study investigates the influence of two math attitudes, perceived usefulness of math and math anxiety, on self-regulated learning. The study also explores the extent to which self-regulated learning strategies and math attitudes contribute to academic performance (final course grade and persistence) in developmental math courses. The study examines demographic (gender, ethnicity, marital status, dependents, hours worked per week, age, parent education) and academic characteristics (enrollment status, math preparation, academic preparation) that are associated with self-regulatory strategy usage, math attitudes, and course persistence in developmental math. Specifically, the research questions are:

1) Are there differences in a) self-regulatory strategy usage, b) math attitudes, and c) developmental math course outcomes (final grades and course persistence) based on demographic and academic variables (i.e., gender, ethnicity, academic preparation, parent education)?
2) Controlling for demographic and academic variables (i.e., gender, ethnicity, academic preparation, parent education), what attitudinal factors (perceived usefulness of math and math anxiety) relate to self-regulated learning among developmental math students enrolled at a community college?
3) Controlling for demographic and academic variables (i.e., gender, ethnicity, academic preparation, parent education), what self-regulatory factors and math attitudes contribute to academic success (final course grades) in developmental math courses among students enrolled at a community college?
4) Controlling for demographic and academic variables (i.e., gender, ethnicity, academic preparation, parent education), what self-regulatory and attitudinal factors predict course persistence (completion/withdrawal) in developmental math courses among students enrolled at a community college?

The answers to these questions provide practitioners and researchers a better understanding of the demographic and academic characteristics, attitudinal factors, and self-regulatory skills that predict success among developmental math students.

Developmental Education and the Community College

Community colleges, as a result of their mission, have played a vital role in educating developmental students (Boylan & Saxon, 1999). Comprehensive community colleges serve several purposes. They provide college transfer programs, general education, and vocational training (Cohen & Brawer, 2003). In addition, they serve the needs of the local community (Cohen & Brawer, 2003). McCusker (1999) argues that, by virtue of their mission, community colleges are the logical institutions in which to house developmental education programs. The provision of developmental education is considered a "key educational task" of community colleges (Provasnik & Planty, 2008, p. 11). Some states have even implemented policies requiring students to take remedial coursework at community colleges (Cohen & Brawer, 2003). Community colleges are the primary providers of developmental education (Boylan, 1999b; NCES, 2000). In fact, ninety-eight percent of public, two-year colleges offered developmental coursework in 2000-2001 (NCES, 2003). Students attending two year colleges are twice as likely as their peers attending baccalaureate institutions to take developmental courses (Livingston & Wirt, 2004; NCES, 2003). Because of the nature of the student body, developmental education has become one of the largest curricular units in community colleges (Boylan & Saxon, 1999).

As a result of their diverse mission and accessibility, community colleges serve a wide array of students. Community college students are more likely than students at other types of institutions to be first generation college students, ethnic minorities, adults, full-time employees, single parents, and financially independent (Cohen & Brawer, 2003; Provasnik & Planty, 2008; Saxon & Boylan, 1999). Such factors can put students at high risk for attrition (Cohen & Brawer, 2003).

Theoretical Framework - Self-Regulated Learning

Academic self-regulation, the ability to control cognitive, metacognitive, and behavioral aspects of learning, is an important aspect of learning in college (Pintrich, 1995; Pintrich & Garcia, 1994; Zimmerman 1990, 1998; Zimmerman & Bandura, 1994; Zimmerman & Martinez-

Pons, 1988). It involves the active participation of individuals in the learning process because, by its nature, it concerns the learner's ability to select and utilize appropriate learning strategies, monitor progress, and evaluate performance (Pintrich, 2000b; Zimmerman, 1990). Zimmerman (1990, 2000) identified three phases of academic self-regulation, namely forethought, performance, and self-reflection. The forethought phase involves motivational influences such as goal setting and planning (Zimmerman, 2000). The second phase, performance, is comprised of maintaining effort, focusing attention, and self-instructing (Zimmerman, 2000). The final phase, self-reflection, is characterized by evaluating one's performance against specified goals or standards (Zimmerman, 2000). "Self-regulated learners plan, organize, self-instruct, and self-evaluate at various stages during the acquisition process" (Zimmerman & Martinez-Pons, 1988, p. 284). They use effective learning strategies, monitor their learning, and respond accordingly. To succeed academically, developmental students would likely benefit from the ability to regulate their learning.

For many students, college represents a shift from teacher or parent-directed learning to self-directed responsibility for one's learning. The theory of self-regulated learning attempts to explain how students actively engage in the learning process and provides some potential reasons why students at similar cognitive levels, such as those enrolled in developmental math, have different patterns of academic achievement (Ablard & Lipschultz, 1990; Zimmerman, 1990). Pintrich and Garcia (1994) suggest that, despite the desire of college students to do well academically, they may have difficulty maintaining focus, especially when confronted with distractions. Since beliefs about learning can affect academic self-regulation, it is possible that attitudes toward math may influence self-regulated learning. Poor self-regulatory skills may help explain the reasons that developmental students are more likely to give up when faced with obstacles (Zimmerman & Bandura, 1994) and that withdrawal rates in developmental math courses are high (Adelman, 2004; Gerlaugh et al., 2007).

Researchers have recommended studying self-regulation in specific academic contexts and with a variety of age and achievement levels to determine if self-regulation is predictive of academic success across ability groups, age, and subject areas (Pintrich, 2000a; Ley & Young, 1998; Ruban, McCoach, & Reis, 2002; Zimmerman, 1998). Developmental students differ from their college-ready peers in self-regulatory strategy usage, indicating a need to further examine self-regulation among developmental students (Ley & Young, 1998; Young & Ley, 2005). Not surprisingly, developmental students reported using self-regulatory strategies less frequently than did college-ready students (Ley & Young, 1998). Young and Ley (2005) reported that developmental learners most frequently used the strategies of reviewing tests, structuring one's environment to avoid distractions, monitoring one's learning, and organizing and transforming study materials. Despite their reported usage of those strategies, no relationship existed between developmental students' strategy use and grades in a study skills course (Young & Ley, 2005). This study examines self-regulated learning among students enrolled in developmental math courses at a community college.

Attitudes toward mathematics.

Several researchers have recommended incorporating attitudes toward learning or the subject matter into studies of cognition and academic achievement (Ikegulu, 1998; McLeod, 1989; Miller, 2000). Ikegulu (2000) recommended future research on how learning styles and individual characteristics influence academic performance in math and other subjects. Miller (2000) suggested further research on math anxiety and perceived relevance of math among developmental students. Singh, Granville, and Dika (2002) indicated that the relationship between attitudes and achievement-related behaviors in math have not been fully investigated and require more research.

Attitudes toward math refer to relatively stable feelings and beliefs about the subject (McLeod, 1992). Studies support the notion that attitudes and beliefs about learning, math, and self are influential to learning and achievement in mathematics (Bassarear, 1986; Chouinard, et al., 2007; Kincaid & Austin-Martin, 1981; Pajares, 1996). Much of the research conducted involves the study of gender differences and the relationship between attitudes and problem-solving (McLeod, 1992).

Looking at math attitudes within the lens of self-regulated learning provides a different framework for the study of math attitudes. Self-regulated learning involves motivational components of learning (i.e., goal orientation, self-efficacy, test anxiety, and task value), in addition to cognitive, metacognitive, and behavioral components of learning (Pintrich, 1995; Pintrich et al., 1991; Zimmerman, 1990; Zimmerman, 2000). Math attitudes, namely perceived usefulness of math and math anxiety, represent motivational components of self-regulated learning and, as such may sustain or inhibit the effort that students put into learning the subject. Thus, math attitudes may comprise the motivational component that is part of self-regulated learning. On the other hand, self-regulation may help students cope better with negative attitudes toward math, thereby helping students to maintain effort and concentration. This study focuses on subject-specific attitudes as potential motivating factors that may influence not only academic outcomes but also the extent to which students engage in self-regulatory strategies. Limited research exists that examines how attitudes relate to self-regulated learning and academic outcomes and, therefore, merits further investigation (Linnenbrink & Pintrich, 2004).

For the purpose of this study, two attitudinal factors, perceived usefulness of mathematics and math anxiety, will be examined. It is hypothesized that perceptions of the usefulness of math influence self-regulatory strategy usage and course outcomes. Perceived relevance of math is positively related to interest in the subject, effort, and confidence in one's ability to learn math (Chouinard et al., 2007; Updegraff & Eccles, 1996). Lack of perceived usefulness of math may affect self-regulatory strategy usage and ultimately course outcomes by hindering motivation and effort. Miller (2000) reported that developmental students expressed views that algebra was not useful or relevant to their lives. Such opinions may impede students from engaging in self-regulatory strategies and from learning math.

Perceived usefulness of math is related to math course-taking patterns, with students who perceive math as more useful exhibiting greater likelihood of continuing the math sequence in high school (Updegraff & Eccles, 1996). A lack of perceived utility of math may prevent students from continuing math courses in high school, thereby leading to underpreparedness for college math. On the contrary, perceptions of math as relevant may motivate students to take advanced math courses and enhance their skills, in which case students would be better prepared for college level math.

Anxiety toward math has also been proposed as an explanation for poor math achievement. In meta-analysis studies, Hembree (1990) and Ma (1999) found that math anxiety was inversely related to math performance. Math anxiety may undermine the performance of developmental math learners (Bitner, Austin, & Wadlington, 1994; Godbey, 1997; Hembree, 1990; Ikegulu, 2000). Gourgey (1984) concluded that math anxiety was a factor that led college students to give up when faced with challenging math problems. Perhaps math anxiety leads to higher withdrawal and/or failure rates among students enrolled in developmental math courses.

On the contrary, students with positive attitudes toward math and those who experience little to no math anxiety may engage more in the learning process and, therefore, perform better. This study examines how math anxiety and perceived usefulness of math relate to self-regulated learning and course outcomes of developmental math students.

Importance of the Study

The inability of students to master basic math skills prevents them from advancing to college level coursework and completing degree programs, thereby limiting their choice of academic majors and careers (Betz, 1978; Bitner et al., 1994; Drew, 1996). By the time students reach college, many have developed negative attitudes toward math and have adopted ineffective study strategies that may lead to poor performance (Pedersen, 1985; Updegraff & Eccles, 1996). Additional research is needed on how motivational, cognitive, and metacognitive factors influence learning among college students (Pintrich, 2000b; Pintrich & Garcia, 1994). Unfortunately, research regarding the attitudes of developmental learners is limited (Chouinard et al., 2007; Saxon & Boylan, 1999). Refresher courses alone do not appear to reduce feelings of anxiety toward math (Gourgey, 1984). It is, therefore, important to help students overcome debilitating attitudes and behaviors through other means. Colleges can begin this process by helping students recognize their attitudes toward math and understand how those attitudes may influence their academic performance.

The results of this study have implications for educational policy. Understanding the role that attitudinal and self-regulatory factors play can lead to the implementation of curricular and policy changes concerning placement and remediation in math. Gerlaugh and her colleagues (2007), in a recent study of community college developmental education programs, found that only 7% of institutions assessed non-cognitive factors; yet, research has shown that such factors may be better predictors of college success among at risk students than the more traditional measures of high school grades and standardized test scores (Sedlacek, 2004). Sedlacek (2004) indicates that college admission testing is inadequate, in part because entrance exams only measure cognitive abilities that do not adequately predict college outcomes of students from diverse backgrounds. He recommends supplementing cognitive measures with non-cognitive assessments that better predict academic success and more effectively diagnose students' abilities and needs in order to enhance their learning (Sedlacek, 2004). Drew (1996) indicates that results of aptitude tests tell little about what people are capable of learning. Aptitude and ability tests alone are insufficient predictors of academic outcomes. A combination of attitudinal, behavioral, and academic factors may provide a more holistic picture of the student's readiness for college coursework, thereby leading to better placement practices (Saxon, Levine-Brown, & Boylan, 2008; Sedlacek, 2004).

If self-regulatory and attitudinal factors influence math course success, institutions can modify placement policies to include affective and self-regulatory assessments, in addition to cognitive assessments. Students who meet certain criteria (i.e., self-regulated learners with positive math attitudes) may be able to remediate more quickly. By expanding the literature on self-regulatory skills to encompass students enrolled in developmental math courses and addressing whether self-directed learning and other attitudinal factors contribute to success in developmental math courses, it is possible that better predictors of performance can be identified. If that is the case, institutions can use the findings to create more effective placement policies by supplementing standardized test results with non-cognitive factors such as self-regulatory skills and math attitudes (Saxon et al., 2008; Sedlacek, 2004). Assessment results can be used to determine whether students are capable of successfully completing college level math or whether they would benefit from developmental coursework (Saxon et al., 2008; Sedlacek, 2004).

By determining the factors that predict success in developmental math courses, intervention programs can be developed to enhance student success (Levine-Brown, Bonham, Saxon, & Boylan, 2008). This may involve explicitly teaching self-regulatory skills to developmental math students or instituting cognitive or behavioral treatments to reduce the effects of math anxiety or other negative attitudes toward math. Instructional components can also be developed to reduce math anxiety and improve attitudes toward math. In order to combat debilitating attitudes toward math, instructors can encourage students to seek help from counselors, advisors, and learning specialists.

Because self-regulatory strategies can be taught (Pintrich & Garcia, 1994), a relationship between self-regulation and student success would suggest that developmental education programs could include instructional components that would not only help students manage attitudes that negatively affect learning but would also enable students to develop effective self-regulatory strategies. If a relationship exists, creating self-regulated learners would be an important component of developmental programs, as those skills would enable students to become independent, lifelong learners. Technological innovations and changes in the workforce demonstrate the need for self-regulated, independent learners who can efficiently respond to changing needs. In fact, Bandura and his colleagues (1996) write, "Technological change and growth of knowledge are placing a premium on capability for self-directed learning" (p. 1219). They go so far as to suggest that the knowledge gap between effective and poor self-regulated learners will increase.

Failure and withdrawal rates in developmental math are the highest among all courses nationwide (Adelman, 2004). Many institutions are seeking ways to lower failure and withdrawal rates in math, move students through the developmental sequence more quickly, increase retention, and reduce instructional costs. By identifying various attitudinal and self-regulatory factors that relate to success in developmental courses, institutions can create policies and procedures that may help higher education administrators achieve those goals. For example, institutions may be able to use the results of this study to develop and implement intervention programs targeted specifically for developmental math students who are less likely to succeed. In addition, they may be able to incorporate the use of non-cognitive assessments to provide better academic advising and counseling for underprepared students (Sedlacek, 2004). In summary, this study is important because the findings can help institutions establish policies and practices that better meet the needs of developmental students by improving their likelihood of success. Enhancing student success benefits not only the students but the institution as a whole.

Literature Review

This chapter presents a review of literature that is relevant to this study. The chapter begins with a discussion of developmental learners and a comparison of the academic success of developmental and college ready students. As the theoretical foundation of the study, the literature on self-regulated learning and academic achievement is presented next, along with a discussion of how it pertains specifically to college students and developmental learners. The chapter culminates with a presentation of the literature regarding the relationship between math attitudes and math performance. In particular, the relationship between math performance and perceived usefulness of math and math anxiety are explored.

More students aspire to attend college than ever before. The vast majority, seventy percent, of high school graduates enroll in postsecondary education within a few years of completing high school, yet increasing numbers of students are entering college academically underprepared (Venezia, Kirst, & Antonio, 2004). Most higher education institutions offer developmental education programs and services to meet the needs and enhance the academic skills of academically underprepared students (Boylan, 2002; Casazza & Silverman, 1996).

Developmental Students and Academic Achievement

Research shows that underprepared college students differ from their college-ready peers in a variety of academic and affective domains. Grimes and David (1999) found that underprepared students were more likely than college-ready students to pursue postsecondary education to improve reading and study skills and to develop job skills. Underprepared students were more likely than their counterparts to describe their reasons for attending college as a means of improving academic skills and satisfying parental wishes which may reflect a lack of commitment to remaining in college and earning a degree (Grimes & David, 1999). Indeed, academically underprepared students reported being less likely to earn a bachelor's degree (Grimes & David, 1999). Developmental students rated themselves lower on perceived academic ability and intellectual self-confidence (Grimes & David, 1999). As may be expected, academically underprepared students were more likely to report that they expected to fail one or more courses, take longer to complete a degree, and receive tutoring (Grimes & David, 1999). In addition, they were less likely to make a B average or earn a bachelor's degree (Grimes & David, 1999). It is possible that such academic and psychological variables may affect students' academic preparation for college (Curtis, 2002).

Several studies have examined the relationship between underpreparedness and academic success with mixed results. McCabe (2000), in a national study of community college developmental education programs, reported that nearly half of developmental students successfully completed remediation and continued to perform well in college level courses. Furthermore, findings from a meta-analysis of studies on developmental education programs at community colleges indicated that two-thirds of research findings noted positive correlations between developmental education and retention (Burley, 1994). Some studies have reported that students who successfully remediate perform better academically and persist longer than students who complete some or no remediation (Batzer, 1997; Crane et al., 2002; Weissman, Silk, & Bulakowski, 1995).

Not all studies report positive results concerning the success of developmental students, however. Bailey, Jeong, and Cho (2010) discovered that less than half of students completed the developmental sequence to which they were referred, and about one-third of students refused to enroll in developmental courses. The findings of Grimes and David (1999) support the notion that underprepared students perform at levels below those of their college-ready peers. They discovered that underprepared students differed considerably from college-ready students on several academic measures including course completion, grade point average, persistence, and graduation (Grimes & David, 1999). Bailey and his colleagues (1995) reported that, among NELS:88 participants, community college students who took at least one developmental course were less likely to earn an associate or bachelor's degree than their college ready peers. Furthermore, Curtis (2002) found that enrollment in developmental education courses did not increase students' likelihood of degree completion. Surprisingly, the data revealed that students for whom developmental math was recommended but who elected not to enroll in it performed better in college level math courses than students who first enrolled in developmental math and subsequently enrolled in college-level math (Curtis, 2002). However, as the researcher cautions, the results may be limited in that they may be more a measure of the inadequacy of the institution's placement procedures or the lack of rigor in the developmental course rather than the student's true academic ability (Curtis, 2002). On the other hand, this finding lends credence to the hypothesis that non-cognitive factors may also predict academic success of developmental students.

Contradictory findings on the success of developmental education may be due in part, to non-standardized practices concerning assessment and placement. The inadequacy of effective placement practices could hinder the success of students. Most institutions that have assessment and placement policies use only cognitive indicators of ability (Gerlaugh et al., 2007; Saxon et al., 2008). Unfortunately, that practice is limited in that it fails to consider other important characteristics, such as attitudes and learning strategies that are likely to influence student success (Saxon et al., 2008). In fact, Nolting (2007) indicates that one-quarter of math performance is based on non-cognitive dimensions. Therefore, assessment of non-cognitive factors would lead to better placement practices than cognitive factors alone (Saxon et al., 2008). Research is limited in that most of the data collected on developmental students' academic success were gathered after students had completed developmental courses. While this provides insight into how developmental students fare in terms of academic outcomes, it does not provide any insight as to the students' attitudes or preferred learning strategies. Only the study by Grimes & David (1999) alludes to the attitudes developmental students bring with them to college; yet, non-cognitive factors are important aspects of academic achievement (Saxon et al., 2008). As Bohuslov (1980) indicates, poor math background, combined with negative attitudes toward math and math anxiety, may impede the performance of "otherwise capable students" (p. 8). This study examines the influence of non-cognitive factors, including learning strategies and math attitudes, on developmental math course outcomes.

The lack of adequate academic preparation for college affects certain segments of the population more so than others. Academically underprepared students are more likely to be economically disadvantaged, students of color, and first generation college students (McCabe, 2000; Wirt et al., 2004). Poverty may be the single most important factor related to academic achievement at all levels of education (McCabe, 2000). Economically disadvantaged students are far less prepared for college than students from middle and upper income families (NCES, 2000). Forty seven percent of students from households with family incomes of less than $25,000 lack adequate preparation for college, compared with 32% of middle class and 14% of upper class students (NCES, 2000).

Nationally, and across institutional types, a greater percentage of students of color are underprepared than their white peers (NCES, 2000). NCES (2000) reported that 32% of white students and 27% of Asian students were underprepared for college, compared with 47% of

Hispanic students, 53% of African American students, and 55% of American Indian students. Findings from the National Study of Community College Remedial Education revealed that 56% of underprepared students were white, 23% were African American, and 13% were Hispanic (McCabe, 2000). White students who attended community colleges and who took at least one developmental course were more likely than their Black or Hispanic counterparts to earn a degree or transfer to a four-year institution (Bailey et al., 2005). Although the majority of underprepared students were white, students of color were overrepresented relative to their participation in postsecondary education (McCabe, 2000). Seriously deficient students, those who are below college level in reading, writing, and mathematics and who need at least one lower level remedial course, were overwhelming represented by minority groups (McCabe, 2000; Crane, McKay, & Poziemski, 2002). McCabe (2000) reported that forty percent of seriously deficient community college students were African American, 22% were Hispanic, 9% were Asian/Pacific Islander, and 6% were "Other." Thus, over 75% of students with serious deficiencies were students of color (McCabe, 2000). While only 5% of white students who were underprepared were seriously deficient, an alarming 20% of underprepared minority students fell into this category (McCabe, 2000). Despite mixed results concerning the relationship between developmental education programs and student success, literature is consistent in that students with multiple or severe deficiencies are the least likely to succeed (McCabe, 2000; Weissman et al., 1995). According to McCabe (2000), only 20% of seriously deficient students successfully completed remediation. Likewise, Weissman and colleagues (1995) reported that triple-deficient (underprepared in reading, writing, and mathematics) students attempted and earned fewer credit hours, had a lower ratio of credit hours earned to attempted, and were less likely to persist than other underprepared students. These figures indicate that seriously deficient students are more likely to be students of color and that developmental education, therefore, affects underrepresented minority groups to a greater extent. As such, race/ethnicity and academic preparation (multiple deficiencies) were selected as variables in this study.

Like students of color, first generation college students are at a disadvantage as related to college preparation. This is because they have less exposure to college and lower levels of academic performance than students whose parents attended college (Chen, 2005; York-Anderson & Bowman, 1991). Given such barriers, it is not surprising that first generation students are more likely to be underprepared than students whose parents are college educated. According to the National Center for Education Statistics, over half, 55%, of first generation students enrolled in at least one developmental course, compared to 27% of students whose parents had at least a baccalaureate degree (Chen, 2005). More than twice as many first generation students took a developmental math or reading course than continuing generation students (Chen, 2005). Forty percent of first generation college students enrolled in developmental math, compared with only sixteen percent of students whose parents had a college degree (Chen, 2005). Furthermore, 13% of first generation students took a developmental reading course, compared with a mere 6% of students whose parents had a bachelor's degree (Chen, 2005). Because the figures demonstrate that the need for remediation is pronounced among first generation college students, parent education was identified as a variable in this study.

Other factors that are related to progression in developmental education include gender, age, and enrollment status (Bailey et al., 2010). Students who are male, non-traditional aged, or part-time are less likely to complete the developmental course sequence (Bailey et al., 2010).

Thus, gender, age, and enrollment status were included as demographic variables in the present study.

Self-Regulated Learning

Self-regulated learning is a useful context for studying the academic success of developmental students. Self regulated learning refers to the acquisition of knowledge and skills through cognitive and metacognitive processes, as well as actual behavior (Zimmerman, 1990). Self-regulated learning characterizes the learning process as active and constructive, involving awareness, monitoring, and management of cognitive, motivational/affective, and behavioral elements (Pintrich, 2000b; Zimmerman, 1990). Cognitive regulation involves knowing when and how to use various learning strategies whereas regulation of motivation and affect involves managing one's motivation and attitudes (Pintrich, 2000b). Behavioral regulation involves the management of overt actions and can include activities such as time management, record keeping, and help-seeking (Pintrich, 2000b). Thus, effective self-regulated learners are able to control their motivation, cognition, behavior, and environment (Pintrich, 2000b).

A variety of self-regulatory strategies exist. Zimmerman & Martinez-Pons (1986) identified the following strategies: goal setting and planning; organization and transformation; rehearsal and memorization; reviewing tests, notes, or texts; seeking information; environmental structuring; help seeking; record keeping and self-monitoring; self-consequences; and self-evaluation (Zimmerman & Martinez-Pons, 1986). Other self-regulatory strategies include elaboration, metacognitive self-regulation, effort regulation, and peer learning (Pintrich, Smith, Garcia, & McKeachie, 1991). A brief definition of the strategies is provided in Table 1.

Table 1
Description of Self-Regulatory Strategies

Self-regulatory Strategy	***Description***
Goal setting and planning	Setting intended learning outcomes or determining study-related actions to be taken.[a]
Organizing and transforming	Outlining, arranging, or classifying information.[bd]
Rehearsal	The repetition or memorization of material.[bd]
Seeking information	Locating and using additional resources to aid in the learning process.[ab]
Environmental structuring	Time and study management techniques that help create an effective learning environment, such as budgeting one's time, setting aside a place to study, making good use of study time, and completing homework.[ab]
Help seeking	Asking a knowledgeable person (i.e., instructor, tutor, classmate) for assistance.[b]
Record keeping/Self-monitoring (Metacognitive self-regulation)	Performing comprehension checks and adjusting learning strategies accordingly.[bd]
Self-consequences	The use of perceived or actual consequences to guide behavior, such as rewarding oneself for successfully accomplishing a task.[a]
Self-evaluation	Setting criteria or standards for learning and critiquing oneself on the basis of those standards.[ab]
Elaboration	Summarizing or paraphrasing information.[bc]
Metacognitive self-regulation	Monitoring, analyzing, and controlling one's learning and making adjustments accordingly. Also involves the knowledge of what self-regulatory strategies to use and when to use them.[bc]
Effort regulation	The ability to stay focused and finish assignments even when the work is difficult or uninteresting.[b]
Peer learning	Studying or discussing concepts with classmates.[b]

[a]Zimmerman, 1998. [b]Pintrich et al., 1991. [c]Pintrich, 2000b. [d]Pintrich and DeGroot, 1990.

Self-regulated learners employ a variety of strategies during the learning process. Strategies such as organizing and transforming information; elaborating; rehearsing and memorizing; and reviewing tests, notes, and texts are examples of cognitive learning strategies that self-regulated students use to acquire knowledge (Zimmerman, 1998). Rehearsal is a more surface approach to learning, whereas strategies such as elaboration and organization/transformation are more complex tasks that require deeper levels of processing (Pintrich et al., 1991). In addition to employing various learning strategies, self-regulated learners use metacognitive (i.e., self-monitoring, self-evaluating) and behavioral strategies (i.e., time management, effort regulation) to keep themselves on track.

Self-regulation has been studied in a variety of academic settings over the past twenty years. Self-regulated learning is particularly relevant for college students since learning in college is primarily considered the responsibility of the student, not a teacher or parent (Zimmerman, 1998). Pintrich and Garcia (1994) contend that self-regulatory strategies are of particular importance for college students because such strategies can be learned. Thus, developmental college students can acquire and apply self-regulatory strategies to enhance their academic success. Bembenutty and Zimmerman (2003) indicate that there is a causal relationship between self-regulated learning and academic achievement. Thus, at risk students who are able to self-regulate may have a better chance of experiencing academic success. Rarely, however, has empirical research on self-regulated learning been applied to developmental math students. Thus, developmental math courses provide an avenue in which to expand studies of academic self-regulation by determining if self-regulation is predictive of outcomes in developmental math courses among community college students.

Self-regulation and academic achievement

A variety of research demonstrates that self-regulatory strategy usage is positively associated with academic outcomes at many levels of education. Students who use deeper processing methods (i.e., elaboration, organization) and who regulate their behaviors (i.e., self-monitoring, self-evaluation) are more likely to experience academic success (Pintrich & Garcia, 1994). Self-regulatory skills are commonly associated with measures of academic achievement including course grades and grade point average (Bembenutty & Zimmerman, 2003; Brothen & Wambach, 2000; Cantwell, 1998; Garavalia & Ray, 2003; Nota, Soresi, & Zimmerman, 2004; Pintrich & De Groot, 1990; Ruban et al., 2002; Trainin & Swanson, 2005; Zimmerman & Bandura, 1994). Self-regulatory strategies that have been associated with academic outcomes (grades and/or grade point averages) among college students include organizing, planning, and transforming (Garavalia & Ray, 2003; Nota, Soresi, & Zimmerman, 2004); self-monitoring (Brothen & Wambach, 2000; Trawick, 1992); and goal setting (Zimmerman & Bandura, 1994). Furthermore, research suggests that higher achieving students appear to have a larger inventory of self-regulatory strategies and greater strategy use than lower achieving students (Ablard & Lipshultz, 1998; Garavalia & Ray, 2003; Pintrich, 2000a; Pintrich & De Groot, 1990; Ruban & Nora, 2002).

Pintrich and DeGroot (1990) reported that self-regulatory strategy usage was a better predictor of academic performance than cognitive strategy usage among seventh grade students in science and English. Through univariate and multivariate analysis of variance, the researchers discovered that comprehension monitoring, goal setting and planning, effort management, and persistence were the strongest predictors of academic outcomes (Pintrich & DeGroot, 1990). Furthermore, students who used the strategies of memorizing, organizing, and transforming material (through rehearsal, elaboration, and organizational strategies) performed better than their peers. Interestingly, they found that students who were more interested in classroom tasks were more likely to use cognitive and self-regulatory strategies (Pintrich & DeGroot, 1990). Thus, it seems logical that students who have positive attitudes toward the subject matter would perform better academically.

Cantwell (1998) investigated beliefs about self-regulatory control processes in high school and college students in Australia. Through correlation analyses, he discovered that self-regulatory beliefs were associated with high performance among university students. For both high school and college students, and males in particular, maladaptive self-regulatory beliefs were associated with poor performance. Interestingly, among secondary students, maladaptive self-regulatory beliefs were related to poor academic performance in English and science but not in math. Cantwell (1998) suggested that the independent learning context of higher education may have prompted changes in college students' beliefs about self-regulated learning. Furthermore, Cantwell (1998) suggested that factors other than self-regulatory beliefs may be more closely associated with math outcomes. Use of actual self-regulatory strategies may influence academic outcomes; however, the focus of Cantwell's study was on beliefs about self-regulated learning rather than actual behaviors.

Nota and her colleagues (2004) studied the relationship between self-regulatory strategies and academic achievement and intent to pursue higher education among Italian high school students. By conducting multiple regression analyses, the researchers found that the strategy of organizing and transforming was highly predictive of academic success, particularly in technical subjects (83%) and Italian (73%) but less so, albeit significantly (23%), in math. Given the large difference in variance that the self-regulatory strategy of organizing and transforming accounted for in math as compared with the other subjects, it is possible that other factors such as attitudes toward math influence success in math perhaps more so than in other subjects. Interestingly, goal setting and planning were negatively correlated with help-seeking, indicating that students who plan and set goals rely less on others for assistance (Nota, Soresi, & Zimmerman, 2004).

Academic self-regulation and college students

Self-regulated learning has important implications for college students because once students enter college, they become primarily responsible for their own learning (Zimmerman, 1998). Studies demonstrate that self-regulatory skills are indeed predictive of college outcomes. Interestingly, the strategy of self-consequences was affiliated with enrollment in postsecondary education, indicating that students who are more aware of the potential benefits of attending college may be more likely to enroll in postsecondary education (Nota, Soresi, & Zimmerman, 2004). The benefits of self-regulatory strategies do not end there, however. Self-regulated college students take responsibility for their learning by initiating and sustaining cognitive, metacognitive, and behavioral processes such as setting learning goals, monitoring their progress, and making adjustments accordingly (Pintrich, 1995; Zimmerman, 1990).

In order to maximize the effectiveness of self-regulatory skills, students must be capable of applying the strategies, especially when other demands and priorities compete for students' attention (Zimmerman & Bandura, 1994). This is a critical aspect of self-regulation and one that developmental math students may not have acquired. Pintrich and Garcia (1994) suggest that despite the desire of college students to do well academically, they may have difficulty maintaining focus, especially when confronted with distractions. Students who face obstacles are more likely to give up if they have low self-regulatory skills (Zimmerman & Bandura, 1994), an important point that may help explain why students enrolled in developmental math courses often withdraw from the course.

In a study of college freshmen enrolled at a highly selective institution in the United States, Zimmerman and Bandura (1994) conducted a path analysis of writing course outcomes and found that two self-regulatory factors, perceived academic self-efficacy and goal setting, accounted for 35% of the variance in writing course grades of students enrolled at a selective postsecondary institution. This supports the hypothesis that non-cognitive factors may be important predictors of academic success among college students. Such findings are encouraging given that self-regulatory strategies can be taught.

In a separate study of university students, researchers concluded that academic, motivational, and self-regulatory strategies were not only predictive of academic success but were also able to distinguish honors students from at risk students (students on academic probation) (Ruban & Nora, 2002). Despite the fact that low achievers demonstrated a relatively high mean on academic dedication (hours spent studying per week), logistic regression analyses revealed that at risk students were more likely to depend on compensatory supports (i.e., use of tape recorders, visual organizers) and help from instructors and classmates than their higher achieving counterparts (Ruban & Nora, 2002). Higher achievers, on the other hand, spent significantly more time studying, had better conceptual skills, and perceived greater benefits from the use of self-regulatory strategies (Ruban & Nora, 2002). Surprisingly, high and low achievers did not differ on study routines (a measure that combined time management and environmental structuring). Another study by Ruban and her colleagues (2002), demonstrated that motivation and self-regulation (defined as conceptual skills, memorization, and compensatory supports) significantly predicted cumulative grade point average above and beyond cognitive variables (i.e., SAT scores, high school rank). The researchers also confirmed that there was a negative relationship between grade point average and reliance on compensatory supports (Ruban et al., 2002). Contrary to other findings, however, the researchers found that neither conceptual skills nor memorization was predictive of academic outcomes (cumulative grade point average) of college students (Ruban et al., 2002).

Results of a different study, however, indicate that frequent use of self-regulatory strategies is related to college success of both learning disabled and non-learning disabled students (Trainin & Swanson, 2005). Trainin and Swanson (2005) conducted multivariate analysis of variance to determine whether group differences existed with regard to cognitive and metacognitive strategy usage. They found that learning disabled students were more likely to engage in help seeking and to use other self-regulatory strategies (resource management, time management, effort regulation, and peer learning) than students without documented learning disabilities (Trainin & Swanson, 2005). Use of those strategies not only predicted grade point average for learning disabled students, frequent usage resulted in higher academic performance for learning disabled students than their non-learning disabled counterparts and students who were not regular strategy users, regardless of disability status (Trainin & Swanson, 2005). These findings suggest that different groups of students may derive different results from specific self-regulatory strategies, such as help-seeking behaviors, perhaps as a result of frequency of use or the source of help (i.e., teachers, peers, or others).

Bembenutty and Zimmerman (2003) investigated whether motivational beliefs influenced self-regulatory strategy usage, homework completion, and math grades following a 15 week instructional program designed to help at risk college students enrolled in an introductory math course at a technical college. The program was intended to help students develop and apply self-regulatory strategies. In a linked course, students were taught strategies such as goal setting and planning, self-monitoring, organization, attention focusing, and self-evaluation that they were required to apply to their math course. Path analyses revealed that self-regulatory strategy usage had a causal relationship with homework completion and math grades. Self-regulation was significantly affected by students' interest in the subject and their willingness to delay gratification. The study demonstrates that at risk students who successfully use self-regulatory strategies are those who are willing to delay gratification of immediate rewards which may increase their likelihood of achieving long-term academic goals. It may be that students engage metacognitive self-regulatory techniques such as goal setting and planning, effort management, and self-consequences in order to delay gratification. The results of their study demonstrate that non-cognitive factors such as motivation and self-regulation influence math outcomes (Bembenutty & Zimmerman, 2003). The literature shows that self-regulated learning is relevant to college students and that it influences academic achievement among various types of students. This study examines the influence of math attitudes and self-regulatory strategy usage on academic success among students enrolled in developmental math courses.

Self-regulation and developmental college students.

A few studies have addressed developmental students' use of self-regulated learning strategies. The results of one study suggest that self-regulatory strategy usage was predictive of high achievement among academically prepared college students but not among developmental learners (Ley & Young, 1998). A few years later, the same researchers examined whether the use of fourteen self-regulatory strategies influenced the grades of first semester developmental students in a freshman success course (Young & Ley, 2005). Student reports (based on a Likert scale and an interview) suggested that developmental students commonly used the following strategies: reviewing tests, environmental structuring, keeping records/monitoring, and organizing and transforming (Young & Ley, 2005). They were less likely to seek information and assistance from teachers and peers but rather to seek help from "others" (Young & Ley, 2005). In addition to using some less effective learning strategies, developmental students also commonly reported using non-self-regulatory strategies such as prayer and willpower (Young & Ley, 2005). The researchers found that total points in the freshman success course did not correlate significantly with any of the self-regulatory strategies (Young & Ley, 2005). Therefore, the researchers concluded that self-regulatory strategies were unrelated to academic achievement among developmental students; however, the study was limited in that there was little variance in final course grades. The researchers concluded that the study skills course may have lacked an adequate point range (over half of the students received 90% or more of the possible points in the course) to detect differences among strategy use and course grades, thereby negating the potential relationship between self-regulation and academic achievement (Young & Ley, 2005). The results may indicate that developmental students either do not know how to use the strategies effectively or do not engage in those tasks often enough to achieve academic success in college (Young & Ley, 2005). However, students responded to the self-regulated learning questions in the first two weeks of the course, which may not have given first semester college students sufficient opportunity to engage in self-regulatory strategies or to determine which strategies would be most useful in college. Moreover, strategies developmental students may use in an orientation course could differ considerably from those needed in developmental math.

Garavalia and Ray (2003) analyzed whether the self-regulatory strategy usage of developmental students enrolled in three levels of developmental reading courses differed by aptitude (placement test scores) and achievement levels (developmental reading course grades). They discovered that organization and planning strategies were significantly associated with grade point average of developmental reading students (Garavalia & Ray, 2003). Multiple analysis of variance revealed that, among developmental reading students, those with lower aptitude and achievement levels differed from their peers in self-regulatory strategy usage (organizing and planning and typical study strategies) and expected and actual reading course grades (Garavalia & Ray, 2003). No differences were found among ability groups on external regulation, however, indicating that developmental students, regardless of aptitude or achievement level, rely considerably on external sources to structure the learning environment (Garavalia & Ray, 2003). This is consistent with Young and Ley's (2005) finding that developmental students were less likely to seek information and assistance from teachers and peers than from "others." Developmental students' reliance on individuals who may not be subject matter experts may have a negative influence on the students' academic outcomes.

Studies of metacognitive measures show promise for enhancing the academic success of developmental students (Brothen & Wambach, 2000; Ruban & Nora, 2002; Trawick, 1992). Developmental students enrolled in a psychology course were encouraged by their instructors to monitor their course progress and record their grades (Brothen & Wambach, 2000). The researchers conducted a step-wise multiple regression analysis to determine factors that were related to final course grades in psychology (Brothen & Wambach, 2000). They found that developmental students' use of self-monitoring was significantly related to final course grades in psychology (Brothen & Wambach, 2000). ACT score was the strongest predictor of course grades, followed by self-monitoring and studying (Brothen & Wambach, 2000).

Trawick (1992) also studied self-monitoring in developmental students. He investigated the effects of an intervention program on the cognitive (reading ability), motivational (self-efficacy), and volitional (action control and self-monitoring) components of self-regulation among students enrolled in developmental reading courses at a community college. The experimental group received instruction on effort management, self-monitoring, and self-efficacy. Although analysis of covariance revealed no overall treatment effects, correlated sample t-tests revealed that the experimental group improved significantly on academic self-monitoring (Trawick, 1992). This indicates that self-regulatory skills can be enhanced through instruction.

Several studies have shown that high achieving students were more likely than low achieving students to engage in behaviors such as goal setting and planning, organizing and transforming, memorizing and rehearsing, elaborating, managing time and effort, reviewing notes and texts, seeking assistance, and self-monitoring and evaluating (Ablard & Lipshultz, 1998; Garavalia & Ray, 2003; Pintrich & De Groot, 1990; Trainin & Swanson, 2005). Low achieving students, on the other hand, were less likely than their higher achieving peers to use self-regulatory strategies (Pintrich & DeGroot, 1990). Among college students, lower achievers were less likely to report perceived benefits from the use of self-regulatory strategies (Ruban & Nora, 2002). However, perceived benefits from self-regulatory strategy usage were related to grade point average (Ruban et al., 2002). Hence, the more students thought that such strategies were helpful, the better the students performed. This study examines the self-regulatory strategy usage of developmental math students and the influence of those strategies on success in developmental math.

Self-regulation and math performance

Researchers maintain that self-regulated learning is context specific (Pintrich et al., 1991; Zimmerman, 1998). Hence, students may have different patterns of strategy use in mathematics than in other subjects. It appears that strategy usage is associated with students' learning goals in math. Pintrich (2000a) reported that eighth and ninth grade students with mastery goal orientations (students focused primarily on learning and understanding) reported significantly greater willingness to take risks in class and to use metacognitive strategies (planning, monitoring, and regulating cognition) in math than their peers who valued grades more than content mastery. Furthermore, students with mastery orientations were significantly less likely than their peers to engage in self-handicapping, the withdrawing of effort in the face of difficulty (Pintrich, 2000a).

Pintrich (2000a) reported that strategy usage (planning, monitoring, and regulating cognition) in math classes declined from 8^{th} to 9^{th} grade while self-handicapping behaviors (i.e., procrastinating, withdrawing effort) increased over the same time period. This indicates that it may be necessary for instructors to encourage students to use self-regulatory strategies in math and to explicitly teach students how to apply such strategies to math. However, Pintrich's (2000a) finding is inconsistent with that of Zimmerman & Martinez-Pons (1990) who reported that self-regulatory strategy usage steadily increased from 5^{th} to 8^{th} to 11^{th} grades. The contrasting findings may be a result of different research methods and analyses or the academic context. Pintrich & DeGroot's (1990) study was context-specific (in math) while Zimmerman & Martinez-Ponz' (1990) was not subject-specific. The methodologies also differed in that Pintrich & DeGroot (1990) used a survey and conducted univariate analyses of variance while

Zimmerman & Martinez-Ponz (1990) used a self-report survey and conducted multivariate analyses of variance. The diverse techniques and contexts may have led to different findings.

Consistent with Pintrich and DeGroot's (1990) findings, Ablard and Lipschultz (1998) reported that gender and mastery learning orientation were related to self-regulatory strategy use among high achieving seventh grade students (those scoring in the 97th percentile or above). They cited goal setting/planning and self-evaluation as students' primary strategies (Ablard & Lipschultz, 1998). Furthermore, they found that females were more likely than males to complete math homework when they did not understand a problem (Ablard & Lipschultz, 1998).

After teaching developmental math for twenty years, Kitchens (1995) proposed a five-step study routine to help students be successful in mathematics. In her book, she suggests that students review their notes and rework math problems, read and reread explanations in the text book, summarize main ideas, complete homework, and preview the next section (Kitchens, 1995). She also recommends that students participate in class, study at appropriate times and places, and seek help when needed (Kitchens, 1995). In essence, she encourages the use of self-regulatory strategies and suggests that students who engage in those behaviors will have less anxiety toward math and will experience greater academic success.

The empirical studies demonstrate that self-regulatory strategies such as self-monitoring and organizing and transforming may be particularly beneficial for developmental students. This study seeks to add to the literature by examining self-regulatory factors that influence the success of academically at risk students enrolled in developmental math courses. Few studies were designed using multiple regression analyses to determine factors that predict students' success in courses, so this particular methodology is fairly unique to the literature on self-regulated learning.

Attitudes Toward Mathematics

For the purpose of this study, attitudes toward math represent the motivational component of self-regulation. Negative attitudes toward math may explain part of the reason that developmental learners may lose focus when faced with challenges or obstacles (Pintrich & Garcia, 1994; Zimmerman & Bandura, 1994). Bembenutty and Zimmerman (2003) suggest that developmental students have a tendency to give up when they encounter difficult academic tasks or distractions. This may be due not only to lack of ability but also to mistaken assumptions about math or negative attitudes (Drew, 1996; Mealey, 1990). Many researchers believe that negative attitudes toward math affect learning (Bassarear, 1986; Chouinard et al., 2007; Fennema & Sherman, 1976; Gourgey, 1984; Ikegulu, 2000; Kincaid & Austin-Martin, 1981; Ma, 1997; McLeod, 1994; Middleton & Midgley, 1997; Stipek et al., 1998; Updegraff & Eccles, 1996). Self-regulated learning provides a new framework for the study of math attitudes. Math attitudes, including perceived usefulness of math and math anxiety, may affect students' motivation by sustaining or inhibiting the degree of effort that students put into learning the subject.

Negative attitudes toward the subject may develop for many reasons including drill and practice techniques, testing situations, and perceptions of math as rules-based (Ruffell et al., 1998). Attitudes toward math may vary depending on the type of math (i.e., fractions, algebra, geometry) (Ruffell et al., 1998). Research shows that math attitudes decline from elementary/middle school to high school (Bassarear, 1986; Kincaid & Austin-Martin, 1981; Ma & Cartwright, 2003; McLeod, 1994; Op't, & De Corte, 2003; Pedersen, 1985; Updegraff & Eccles, 1996). This is an indication that students may have relatively poor math attitudes by the time they reach college.

Math attitudes differ by gender with males generally having more positive attitudes toward math than females (Bohuslov, 1980; Ma & Cartwright, 2003; Updegraff & Eccles, 1996). Males are more likely to believe that math has both occupational and daily purposes, whereas females view math as primarily occupation-oriented (Bohuslov, 1980). Moreover, females generally perceive math as less useful and exhibit higher math anxiety (Bohuslov, 1980; Ma & Cartwright, 2003) although they typically earn higher grades than do males (Ikegulu, 2000; Updegraff & Eccles, 1996). Interestingly, Bassarear (1986) found that the relationship between math ability and academic achievement was stronger for males than females even though ability is generally the strongest predictor of math achievement for both males and females (Bassarear, 1986; Gourgey, 1984; Keif & Stewart, 1996).

It is generally assumed that attitudes influence behavior (Ruffell et al., 1998). In a review of research appearing in the *Journal for Research in Mathematics Education*, McLeod (1994) reported that attitudes and perceptions about math are related to math performance. Stipek and her colleagues (1998) found that factors such as academic risk-taking, enjoyment of math, and positive feelings toward math were correlated with learning math among fourth to sixth grade students. Likewise, Miller (2000) reported that enjoyment of math was related to understanding of the material among developmental math students while Ma (1997) found that a reciprocal relationship between attitude measures (enjoyment, difficulty, and importance) and achievement existed among high school math students from the Dominican Republic. Using structural equation modeling, Ma (1997) discovered that enjoyment of math was a better predictor of math achievement than was perceived difficulty; however, he noted that there was also a relationship between enjoyment of math and perceived difficulty, with students who perceived math as difficult being less likely to enjoy it (Ma, 1997). Thus, he surmised that lack of enjoyment or perceived difficulty may lead to increased drop out risk. He pointed out, however, that high achieving students do not necessarily enjoy math either (Ma, 1997).

In a study by Sherman and Fennema (1977), math attitudes differentiated high and low math achievers, with high achievers having significantly better attitudes toward math. Conducting analysis of variance, the researchers found that math attitudes were predictive of math achievement (Fennema & Sherman, 1977) and enrollment in advanced math courses among high school students (Sherman & Fennema, 1977). They concluded that math attitudes likely influence female students' decisions to take advanced high school math courses.

Not all studies demonstrate a relationship between attitudes and achievement, however. Gourgey (1984) reported that arithmetic skills were the strongest and only significant predictor of success in a college statistics course whereas misconceptions about math and math self-concept were not significantly related to achievement. Contradictory findings of the relationship between math attitudes and math performance may have to do with age of the subjects, the attitudes and beliefs being studied, and different indicators of achievement.

Math attitudes and developmental students

Math attitudes have not been readily examined in underprepared college students. As part of a qualitative study, Miller (2000) interviewed developmental math students and discovered that attitudes of low achieving students inhibit their motivation; however, perceptions of the usefulness of math and early math success helped alleviate negative attitudes toward math. Developmental students expressed a lack of confidence and frustration about math but indicated that enjoyment of math was associated with their understanding of the material (Miller, 2000). Miller (2000) noted that determination was a key characteristic of high achieving developmental math students. It seems likely that determination is related to the self-regulatory strategy of effort regulation.

In a quantitative investigation of the attitudes of developmental students, Bassarear (1986), using multiple regression analysis, came to a similar conclusion. He found that beliefs about learning, the nature of math, and self-concept were predictive of math performance among developmental math students. He found that after controlling for ability, beliefs (about learning, math, and self) as a whole were significantly related to math achievement (Bassarear, 1986). Perhaps the most significant finding from his study was that the relationship between math attitudes and math performance varied considerably by ability level even among developmental students (Bassarear, 1986). Ability was a much stronger predictor of math achievement for the low and high ability groups, whereas attitudes toward math (specifically, confidence, math anxiety, and attribution for success) were more predictive of achievement than ability among the moderate ability group (Bassarear, 1986). This study examines attitudes toward math and their influence on academic achievement among developmental math students.

Perceived usefulness of mathematics

Perceptions about the usefulness and relevance of math are related to math achievement and math attitudes (Greene, DeBacker, Ravindran, & Krows, 1999; Op't & De Corte, 2003; Singh et al., 2002). Perceived usefulness of math is positively related to perceived value of math, confidence in math ability, interest, effort, and motivation (Chouinard et al., 2007; Kazelskis, Reeves, Kersch, Bailey, Cole, Larmon, Hall, & Holliday, 2000; Op't & De Corte, 2003; Updegraff & Eccles, 1996) and negatively associated with math anxiety (Kincaid & Austin-Martin, 1981). It appears that perceptions of math may influence course-taking decisions and may differ based on age and gender. In a study of 7^{th} to 11^{th} grade math students in Canada, researchers found that students who felt competent were more likely to perceive math as useful and to exert greater effort (Chouinard et al., 2007). The researchers recommended expanding research in this area to developmental learners (Chouinard et al., 2007). Fennema & Sherman (1977) indicated that math attitudes remained relatively constant throughout the high school years but noted that the relationship between math achievement and usefulness of math was stronger for 12^{th} grade girls than for their younger counterparts. Researchers conducting longitudinal studies have suggested that perceptions of the usefulness of math decline significantly from middle school to high school (Ma & Cartwright, 2003; Pedersen, 1985). Updegraff & Eccles (1996) found that perceptions of the relevance of math were related to course-taking patterns in high school which echoes the findings of Sherman & Fennema (1977). Pedersen (1985) reported that perceptions of the usefulness of math predicted course-taking patterns among high and average achieving eighth grade males (but not females) and high achieving twelfth grade females (but not average achieving females or males who were either average or high achievers). Perceptions of math as irrelevant may prevent students from continuing math courses in high school, thereby leading to underpreparedness for college math.

It appears that gender and ethnic differences exist with regard to perceived relevance of math (Chouinard et al., 2007; Ma & Cartwright, 2003). Research demonstrates that males in middle school and high school perceived math as being more useful than did females (Ma & Cartwright, 2003; Updegraff & Eccles, 1996); however, Andre and his colleagues (1997) found that the reverse was true in fourth to sixth grade students. Perceptions of the relevance of math also differ by ethnicity. Ma & Cartwright (2003) found that white students' perceptions of math's relevance declined significantly more between middle school and high school than perceptions of Black and Asian students over the same time period. Although they found that males perceived math as more useful and spent more time on math-related activities outside of school, Sherman & Fennema (1977) cautioned that gender differences were not as pronounced after controlling for other variables (such as achievement level, ability, and intent to pursue advanced math).

Drew (1996) stated that, "Perseverance and hard work, not intelligence or aptitude, are the key factors" (p. 217) to learning in math and science. The results of the study by Chouinard and his colleagues (2007) appear to confirm Drew's belief. Using structural equation modeling, Chouinard and his colleagues (2007) concluded that perceptions of the usefulness of math among Canadian students in seventh through eleventh grades were indirectly related to the amount of effort exerted. Thus, math attitudes and self-regulated learning strategies, such as effort regulation, may be related. However, the study excluded developmental students, so the results of that particular study are not reflective of the attitudes or effort of developmental math students (Chouinard et al., 2007).

Miller (2000) in her qualitative study of the attitudes of developmental math students, reported that students perceived Algebra as irrelevant to their lives. She cautioned that the perception of math as irrelevant may undermine the motivation of developmental students (Miller, 2000). Surprisingly, Ma (1997) reported that lower achieving students were more likely to believe that math was important than their higher achieving peers. In his study of the influences of math attitudes and beliefs on achievement, Bassarear (1986) reported that perceived usefulness of math was not uniquely predictive of math performance among developmental students. However, experts tend to believe that math curricula should include practical and relevant problems (Drew, 1996) as that may enhance students' perceived usefulness of math (Keif & Stewart, 1996). This study investigates perceptions of the usefulness of math among developmental math students and the influence of perceived usefulness of math on developmental math course outcomes.

Math anxiety

Feelings about math as irrelevant may undermine motivation, as may feelings of anxiety. Math sometimes evokes feelings of dread, fear, and panic that can impede concentration and recall (McLeod, 1992). This phenomenon, referred to as math anxiety, is a psychological and physiological barrier that results in "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551).

Math anxiety is comprised of both cognitive and affective components (Bessant, 1995; Ho, Senturk, Lam, Zimmer, Hong, Okamoto, Chiu, Nakazawa, & Wang, 2000). The cognitive component is primarily characterized by worry (Ho et al., 2000) while the affective components include feelings such as fear, nervousness, dread, and dislike for the subject (Fennema & Sherman, 1976; Ho et al., 2000; Kitchens, 1995) that may lead to poor performance (Betz, 1978; Green, 1990) or avoidance of math altogether (Ho et al., 2000). Math anxiety can involve mental and physical reactions including nausea, difficulty concentrating, blanking out, and negative self-talk (Kitchens, 1995). Ikegulu (1998) reported that students with math anxiety only take math because it is required. He indicated that students who are math anxious avoid math, fail to complete homework assignments, and have a tendency to procrastinate (Ikegulu, 1998). Math anxiety is an important construct to study because it may limit the occupational and educational choices of students who perform poorly in math and/or who avoid math altogether (Betz, 1978; Hembree, 1990).

Generally, positive attitudes toward math are inversely related to math anxiety (Gourgey, 1984; Kincaid & Austin-Martin, 1981). Perceptions of math as useful were negatively related to anxiety for female college students with low math anxiety but unrelated among students with high levels of anxiety (Kincaid & Austin-Martin, 1981). Multiple regression analyses revealed that among math self-concept, arithmetic skills, and beliefs about math, only math self-concept was predictive of math anxiety (Gourgey, 1984).

Although math anxiety tends to be more pronounced and intense during evaluative situations, it is not limited to those situations (Alexander & Cobb, 1984; Betz, 1978; Ikegulu, 1998; Ikegulu, 2000). Researchers have noted that math anxiety is more encompassing than test anxiety (Bessant, 1995; Betz, 1978; Green, 1990) as it involves "a general fear of contact with mathematics" (Hembree, 1990, p. 45) and can involve emotional reactions to "reading, studying, thinking about, and using a wide range of math skills" (Bessant, 1995, p. 336).

Interference and deficit models of math anxiety have been proposed as explanations for math anxiety (Ma, 1999). The interference model posits that math anxiety hinders the recall of information (Tobias, 1985). The deficit model, on the other hand, presumes that the opposite is true: that poor performance, including poor study and test-taking skills, leads to math anxiety (Tobias, 1985). Based on results of a meta-analysis study, Hembree (1990) concluded that math anxiety appears to hinder math performance, supporting an interference rather than deficit model. However, it is generally believed that math anxiety is more prevalent and intense among students with poor math backgrounds (Betz, 1978, Godbey, 1997; Hembree, 1990).

Bessant (1995) studied whether various forms of math anxiety were related to learning strategies and styles. Anxiety over math in general and math tests, in particular, was related to reliance on memorization (Bessant, 1995). An achievement strategy approach (that involves note-taking, time management, and reviewing) to learning was unrelated to any measures of math anxiety; however, a surface approach that relies heavily on memorization was highly correlated with general evaluation anxiety and problem-solving anxiety (Bessant, 1995). A surface motive that involves learning for the mere sake of acquiring credentials (extrinsic motivation) was associated with math test anxiety and general evaluation anxiety. This study examines math anxiety among developmental math students and investigates the influence of math anxiety on developmental math course outcomes. The current study identifyies the influence of study strategies and math attitudes on the achievement of developmental math students.

Relationship between math anxiety and math performance.

Math anxiety has been proposed as an explanation for poor math achievement. In separate meta-analysis studies, Hembree (1990) and Ma (1999) reported that math anxiety was inversely related to math performance among individuals of various ages. Math anxiety has been associated with math performance before and during college (Betz, 1978; Cooper & Robinson, 1991; Green, 1990; Hembree, 1990). Math anxiety is common among college students (Betz, 1978) but more so among students majoring in the arts than those majoring in science (Bessant, 1995).

Math anxiety and developmental students.

High math anxiety may be characteristic of developmental math learners (Bitner et al., 1994; Godbey, 1997; Hembree, 1990). Developmental students who suffer from math anxiety not only face the challenge of overcoming a skills deficit but also overcoming their fears. Not surprisingly, math anxiety is inversely related to academic performance (Green, 1990; Ikegulu, 2000). Green (1990) reported that although math anxiety was significantly related to math achievement of developmental math students, other factors such as test anxiety, math placement test scores, and teacher feedback were stronger predictors of math grade. Although math test anxiety is a large part of math anxiety (Alexander & Cobb, 1984), Green (1990) found that, even after controlling for math test anxiety, general math anxiety contributed independently to math course grades of developmental students. Interestingly, Bassarear (1986) found that poor performance in math was related to high math anxiety among medium and high ability students; however, highly anxious students with low ability actually outperformed lower ability students who expressed less anxiety.

Students with less anxiety may have more strategies at their disposal than their more anxiety-prone counterparts. Conducting multiple analyses of variance, Peskoff (2000) found that, among community college students enrolled in developmental math and precalculus courses, those with low levels of math anxiety used a greater array of coping strategies than highly anxious students. The present research will focus on other types of strategies, namely self-directed learning strategies, and their relationship to math anxiety and performance in math courses.

Ikegulu (2000) studied the influence of gender and math anxiety on the academic performance and persistence of developmental college students. Surprisingly, he (2000) reported that the cumulative grade point average and persistence rates (months in college) did not differ between high and low math anxiety groups. T-tests revealed no differences between developmental students with low and high levels of anxiety which contradicts one of his own previous studies (Ikegulu, 1998; Ikegulu, 2000). In his 1998 study of college math students, he found that math anxiety contributed 27% of the variance in academic performance (cumulative grade point average) among college students enrolled in various levels of math. As would be expected, in his 2000 study that focused exclusively on developmental learners, he reported an inverse correlation between math anxiety and academic achievement (Ikegulu, 2000). Furthermore, analysis of variance revealed that math anxiety and gender interacted together in significantly influencing the cumulative grade point average of developmental students (Ikegulu, 2000). The cumulative grade point average and persistence rates of female developmental math students were higher for both the low and high anxiety groups than for male developmental math students with the respective level of math anxiety (Ikegulu, 2000). That was not the case, however, in his previous study, as it revealed no interaction effect among college students enrolled in developmental to advanced levels of math (Ikegulu, 1998). Ikegulu's research demonstrates that the combined effect of math anxiety and gender may influence the academic performance of developmental students differently than their college-ready peers (Ikegulu, 1998, 2000). Both studies used cumulative grade point average as the dependent variable; however, that measure may not accurately reflect students' performance in math courses (Ikegulu, 1998, 2000). Thus, the present study uses math course grades and course completion as the dependent variables.

Demographic characteristics and math anxiety.

Differences exist with regard to math anxiety on the basis of demographic characteristics, including ethnicity, gender, and age. By the time students reached high school, math anxiety had increased significantly faster among white students than Asian and Black students (Ma & Cartwright, 2003). Ho and his colleagues (2000) investigated differences in the cognitive (worry) and affective (nervousness, fear, dread) dimensions of math anxiety on math achievement of students from the United States, Taiwan, and China. Through structural equation modeling, they discovered that affective dimensions of math anxiety inversely affected math performance among students from all three nations; whereas the cognitive dimension of math anxiety only affected the performance of Taiwanese students. Because cognitive math anxiety was positively related to achievement in Taiwanese students, the researchers inferred that worry may serve as a motivating factor among Taiwanese students (Ho et al., 2000). Thus, it appears that math anxiety may relate differently to math performance for students of various racial and ethnic backgrounds.

Betz (1978) found that non-traditional aged women were more prone to math anxiety than were traditional-aged college students. Likewise, Bessant (1995) concluded that non-traditional aged students experienced more math anxiety. Bitner's (1994) results differed, however. He reported that traditional and non-traditional aged students did not differ in math anxiety levels prior to psychological treatment. Following a study in which the experimental group received systematic desensitization treatments, Bitner and his colleagues (1994) found that math anxiety decreased more in traditional aged than non-traditional aged students. Thus, it appears that the treatment was more helpful to younger students.

Some studies have indicated that female college students are more likely to experience math anxiety than their male counterparts (Bessant, 1995; Hembree, 1990). Contrary to that, other researchers found that the prevalence of math anxiety was similar in males and females (Alexander & Cobb, 1984; Cooper & Robinson, 1991; Kazelskis et al., 2000; Ma, 1999). Fennema and Sherman (1977) reported that gender differences in math performance did not exist after accounting for math background and affective measures. Likewise, Alexander and Cobb (1984) did not find gender differences in math anxiety among college students. However, Hembree's (1990) meta-analysis study revealed that, at pre-college levels, the effects of math anxiety were more pronounced in males than females. Thus, it seems that differences in math performance may be more a function of math ability and attitudes than gender.

Concerning first generation college students, Ikegulu (2000) reported that there was no interaction between first generation status and math anxiety on cumulative grade point average. It is possible, however, that first generation status could influence course completion and/or grades in math courses.

Much of the research on math attitudes has been concerned with group differences in attitudes; thus, much of the research involves analysis of variance. The purpose of this study differs from much of the previous research in that it involves, not a focus on group differences, but rather predictors of academic success in developmental math courses. Gourgey (1984) and Bassarear (1986) conducted multiple regression analyses to identify skills and attitudes that were predictive of math performance. A few studies included non-cognitive factors in the study of math. For example, Bessant (1995) studied the relationship between approaches to learning and math anxiety while Peskoff (2000) investigated whether levels of math anxiety influenced coping strategies. McLeod (1989) suggested that there is a need to incorporate affective factors into studies of cognition and learning. The current study does so. It differs from previous research in that it examines the relationship between self-regulated learning and math attitudes. Specifically, it assesses the influence of math attitudes and self-regulated learning on math performance of developmental students. By utilizing multiple regression analyses, the data will lead to a better understand of specific factors that influence success in developmental math courses. As Ikegulu's (1998, 2000) studies make clear, developmental students' attitudes and behaviors may, along with their subsequent academic performance, differ from those of their college-ready peers.

Summary and Research Questions

Self-regulatory strategies and attitudes toward math appear to influence learning. Strategies such as self-monitoring and organizing and transforming have been linked to academic outcomes (Brothen & Wambach, 2000; Garavalia & Ray, 2003). Perceived usefulness of math is positively associated with several important factors including confidence in math ability, interest, effort, and motivation (Chouinard et al., 2007; Kazelskis et al., 2000; Op't & De Corte, 2003; Updegraff & Eccles, 1996). Math anxiety, on the other hand, is negatively related to educational outcomes (Betz, 1978; Cooper & Robinson, 1991; Green, 1990; Hembree, 1990). It appears that non-cognitive factors such as beliefs, attitudes, and learning strategies influence the success of college students. This study investigates the influence of learning strategies and attitudes toward math on academic success in developmental math courses.

This study enhances awareness and understanding of non-cognitive predictors, including self-regulatory learning strategies and math attitudes, of student success in developmental mathematics courses. Developmental education generally relies on cognitive indicators to determine students' knowledge and likelihood of success in math. However, academic learning is not limited to cognitive development. Other factors such as study strategies and attitudes toward math may also influence developmental students' performance in math courses. This study helps determine factors that may better enable institutions to predict student success in development math courses, thereby laying the foundation for further success in college.

Research on the influence of non-cognitive measures on the success of developmental students is relatively new, and rarely do higher education institutions use non-cognitive factors in conjunction with cognitive measures, for placement purposes. In fact, Gerlaugh and her colleagues (2007) reported that, among community and technical colleges, only seven percent used non-cognitive forms of assessment for placement purposes. To date, developmental education has relied primarily on cognitive assessment measures; however, affective measures, if related to academic outcomes, would be useful as part of the assessment and placement process.

Self-regulated learning provides the theoretical foundation for the present study that investigates the behaviors and attitudes that influence learning among developmental math students. The study incorporates attitudes toward math as a motivational component, a factor absent from recent literature on student learning (Linnenbrink & Pintrich, 2002). This framework helps provide insight into how developmental students go about learning, the tools (strategies) they use, and whether those strategies influence academic performance. Findings from the study can provide insight into the practice of developmental education. As developmental education is a large and ever-growing aspect of higher education, it is important to ascertain factors that lead to success in developmental courses.

Methodology

The purpose of the study is to examine factors, specifically, math attitudes and self-regulated learning strategies, that are hypothesized to relate to success in developmental math courses taken by community college students. In particular, the study addresses a) the differences in math attitudes, self-regulated learning, and course outcomes based on demographic and academic characteristics; b) the influence of math attitudes (math anxiety and perceived usefulness of math) on self-regulated learning; and c) the attitudinal and self-regulatory factors that influence course outcomes (grades and course persistence) in developmental math. Students with negative attitudes toward math and those who lack the sustained effort to learn when faced with difficult and/or seemingly irrelevant material were presumed to be less likely to succeed in developmental math courses. The study was conducted in order to provide insight as to the factors that may facilitate student success in developmental math courses.

Institution

The study was conducted at a large comprehensive, public community college located in the Midwest. The College consists of six primary sites, a virtual college, and numerous other smaller locations (Organizational Overview, 2008). The College is unique in that it serves a major metropolitan area as well as more rural communities (Organizational Overview, 2008). The institution serves approximately 12,500 students annually.

The community college's mission is to "develop responsible, involved lifelong learners and to contribute to the vitality of the communities it serves" (Organizational Overview, 2008, p. 2). The College offers associate degrees (Associate in Arts, Science, Applied Science, and General Studies) and certificate programs, including both career and transfer programs. The

College offers programs in a variety of fields including business, health care, computer information technology, math and science, education, and humanities and fine arts. The purpose of the College's developmental education program is to "prepare learners for success in the college setting" (Organizational Overview, 2008, p. 3).

Between 2001-2005, the student population was primarily Caucasian (72%), followed by African American (10%), Hispanic (6%), Asian (6%), and American Indian/Alaskan Native (1%) (ACT Faces of the Future, 2001-05). The remaining 5% were mixed race or not reported (ACT Faces of the Future, 2001-05). The majority of students, 51%, were between the ages of 18-22. Well over half of the students were female (60%), attended part-time (66%), were employed at least half time (71%), and were first generation college students (greater than 50%) (ACT Faces of the Future, 2001-05).

Institutional policy requires that new students demonstrate readiness for college level courses. New students are required to take a placement exam before they can enroll in math and English courses unless they have already completed a college level course in that area or their combination of high school grades and ACT/SAT scores indicate readiness for college level work. Students are placed into developmental reading, writing, and mathematics courses based on placement exam scores. The College offers two levels of developmental courses in reading, three in writing, and five in math. As described in Table 2, five levels of developmental math courses are offered at the institution.

Table 2
Description of Developmental Math Courses at Host Institution

Developmental Math Courses	Description	Credit Hours
MA 010 Basic Arithmetic	Course content emphasizes addition, subtraction, multiplication, division, and whole numbers	1
MA 020 Fractions, Decimals, and Percents	This course involves adding, subtracting, multiplying, and dividing fractions and percents	1
MA 040 Basic Algebra Concepts	This course covers basic algebra including signed numbers, equation solving, word problems, exponents, roots, and polynomials	1
MA 050 Contemporary Basic Math	This course includes arithmetic, variables, negative numbers, algebraic expressions, and techniques for solving equations	3
MA 060 Fundamentals of Algebra	This course covers basic algebraic concepts, simplifying expressions, factoring, operations with fractions, solving equations, exponents, and radicals	3

Note: Community College Catalog, 2010.

Students enroll in developmental math courses based on either having a placement test score within the designated range or having successfully completed the previous level course. Whether students place directly into the respective course or they completed the previous level math course, they presumably begin the course at similar skill levels. Because MA010 (Basic Arithmetic), MA020 (Fractions, Decimals, and Percents), and MA040 (Basic Algebra Concepts) are one credit hour courses offered through the Academic Achievement Center and only include basic mathematical operations, they were not included in this study. Instead, the study focused on students at the MA050 (Contemporary Basic Math) and MA060 (Fundamentals of Algebra) levels. Contemporary Basic Math and Fundamentals of Algebra are traditional three credit hour courses offered through the math department. In summer and fall 2009, the vast majority of courses at the MA050 and MA060 levels were taught using traditional classroom-based techniques, but a handful of sections were offered in an online format. Only traditional (face-to-face) sections were included in this study.

A total of 857 students were enrolled in Contemporary Basic Math (MA050) and Fundamentals of Algebra (MA060) in fall 2009 (Course Schedule, 2009). Pass rates averaged 69.3% in Contemporary Basic Math and 63.3% in Fundamentals of Algebra from 2006-2008 (Performance Agreement, 2009). Pass rates are defined as grades of C or higher since that is the minimum grade required for advancement to the next course level.

Developmental courses do not count toward graduation requirements and are not computed in the student's grade point average. Although grades for developmental courses are not calculated as part of the student's cumulative grade point average, successful completion of the courses (defined as earning a C or better) is required before students may progress to the next level. Students who withdraw are required to re-take the course and earn a passing grade before registering for the next course in the sequence (College Catalog, 2010).

Access and Permission

Approval to conduct the study was requested from the Human Subjects Committee at the University of Kansas. The Human Subjects Form along with a cover letter, Informed Consent Form, and survey were submitted for review. Due to the nature of the study, an expedited review was requested and approved (approval notification and subsequent email communication is located in Appendix A). Approval to administer the survey to students was granted by the dean responsible for the math department at the cooperating community college (email communication is located in Appendix B). After approval was granted from the home and participating institutions, the data collection process began.

Sample

The target population for the study was students enrolled in Contemporary Basic Math and Fundamentals of Algebra in summer and fall 2009. In summer 2009, three sections of Contemporary Basic Math and six sections of Fundamentals of Algebra were offered. Ten sections of Contemporary Basic Math and eighteen sections of Fundamentals of Algebra were offered in fall 2009. Only sections that ran the full term were included in the study to maintain consistency. Instructors of each section were given a packet of materials including an instruction sheet, informed consent forms, and surveys (a copy of these materials can be found in Appendices C-E). Detailed instructions on how to administer the survey were provided, including a date range in which to conduct the surveys and a script to use when administering them. For the summer term, instructors were asked to conduct the survey between June 22 and July 10, 2009. The date range for administration of the surveys during the fall term was October 5 to 24, 2009. That was midway through each semester and prior to the withdrawal deadline. Instructors determined the best time to administer the survey (within the specified date range) to their respective classes since completion of the survey involved the use of class time.

With the help of the instructors, the surveys were administered. Eight of nine potential sections of Contemporary Basic Math and Fundamentals of Algebra participated in the summer, as did twenty-four of twenty-eight fall sections. Students enrolled in the participating math sections were asked to sign an informed consent form, acknowledging their agreement to participate in the study and their awareness that their rights will be protected. Students were given the option to withdraw from the study at any time. Participants were assured as to the confidentiality of the data collected. Students who agreed to participate signed the informed consent form and completed the survey. Among participating math sections, there was a total enrollment of 636 students. As shown in Table 3, 418 of the 636 potential students submitted a survey, resulting in an overall response rate of 65.7%. Upon review of the surveys, some were determine not to be valid. Surveys were considered invalid and were eliminated from consideration if the consent form was not signed (24), the student was under age 18 (7), or inconsistencies (i.e., patterns) in responses were present (11). There were 376 valid surveys, resulting in a modified response rate of 59.1%. Of the 376 participants, 78 were enrolled in developmental math during summer 2009 and the remaining 298 participants were enrolled in fall 2009.

Table 3
Survey Response Rate

Number of Potential Students Enrolled in Respective Sections	Response Rate (Total Surveys)		Response Rate (Valid Surveys)	
	#	%	#	%
636	418	65.7%	376	59.1%

Research Questions

The purpose of this study was to examine the relationship among math attitudes, self-regulated learning, and academic success in developmental math courses as self-regulatory and attitudinal influences may enable or inhibit students from successfully completing the course. In particular, this study examined the influence of math attitudes on self-regulated learning. Then the extent to which self-regulated learning and math attitudes contributed to academic success (final course grade and course persistence) in developmental math courses was explored. The following research questions were addressed:

1) Are there differences in a) self-regulatory strategy usage, b) math attitudes, and c) developmental math course outcomes (course grades and persistence) based on demographic variables (i.e., gender, ethnicity, age, academic preparation, parent education level)?
2) Controlling for demographic and academic variables (i.e., gender, ethnicity, academic preparation, parent education level), what attitudinal factors (perceived usefulness of math and math anxiety) relate to self-regulated learning among developmental math students enrolled at a community college?
3) Controlling for demographic and academic variables (i.e., gender, ethnicity, academic preparation, parent education level), what self-regulatory factors and math attitudes contribute to academic success (course grades) in developmental math courses among students enrolled at a community college?
4) Controlling for demographic and academic variables (i.e., gender, ethnicity, academic preparation, parent education level), what self-regulatory and attitudinal factors predict course persistence (completion/withdrawal) in developmental math among students enrolled at a community college?

Data Sources & Instrumentation

Three instruments were used for the study: a researcher-developed demographic questionnaire, a revised version of the Motivated Strategies for Learning Questionnaire (Pintrich et al., 1991), and two of twelve scales from the Fennema-Sherman Math Attitudes Scales (1976).

Demographic survey.

The researcher-developed demographic survey was used to collect demographic information from the subjects. Given the theoretical foundation of the study and the literature on community college students, a number of independent variables were included in the analyses. The following self-reported variables were obtained from the survey: gender, ethnicity, age, enrollment status, hours worked, marital status, number of dependents, parent education level, math preparation, and academic preparation.

Motivated Strategies for Learning Questionnaire (MSLQ).

A learning strategies questionnaire was used to measure students' academic self-regulation as it relates to math. The scale consisted of 37 items adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Paul Pintrich, David Smith, William McKeachie, Teresa Garcia, and a team of researchers (Pintrich et al., 1991). The MSLQ was designed specifically "to assess college students' motivational orientations and their use of different learning strategies for a college course" (Pintrich et al., 1991, p. 3). The MSLQ, an 81 item self-report instrument, measures student motivation and self-regulated learning in a course-specific context (Pintrich et al., 1991). Because it is course-specific, norms are not available as responses vary by course (Pintrich et al., 1991). Approval to use and modify the Motivated Strategies for Learning Questionnaire was granted by William McKeachie, one of the developers of the instrument (email approval is presented in Appendix F).

The MSLQ consists of two sections, student motivation and learning strategies (Pintrich et al., 1991). The 31 item motivation section assesses students' beliefs about task value, self-efficacy, and goal orientation. The learning strategies section consists of 50 items that measure cognitive, metacognitive, and resource management strategies (Pintrich et al., 1991). The MSLQ consists of fifteen scales, all of which can be used individually or collectively, including six motivational scales (Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Value, Control of Learning Beliefs, Self-Efficacy for Learning & Performance, and Test Anxiety) and nine learning strategies scales (Rehearsal, Elaboration, Organization, Critical Thinking, Metacognitive Self-Regulation, Time and Study Management, Effort Regulation, Peer Learning, and Help Seeking) (Pintrich et al., 1991).

While the motivational variables of the MSLQ focus on students' self-perceptions and beliefs, the learning strategies variables consist of specific strategies that students use to control cognitive, metacognitive, and behavioral aspects of learning (Pintrich et al., 1991). Students rate themselves on a scale of 1 (Not at all true of me) to 7 (Very true of me) (Pintrich et al., 1991). Some items are reverse coded, so ratings of those items are adjusted before scores are computed (Pintrich et al., 1991). Scale scores are determined by taking the mean of each scale, and higher values represent greater levels of academic self-regulation (Pintrich et al., 1991).

The MSLQ was under development from 1982-1991 and has been tested extensively for reliability and validity (Pintrich et al., 1991). Confirmatory factor analyses were conducted separately for the motivation and learning strategies scales (Pintrich et al., 1991). For the learning strategies scale (since it is the only one included in this research study), the chi-squared to degrees of freedom ratio was 2.26, the goodness of fit index was .78, the root mean residual was .08, and Hoelter's critical number was 180 (Pintrich et al., 1991). The results demonstrate reasonable validity, especially considering the broad expanse of subjects and courses included in the study (Pintrich et al., 1991).

The Motivated Strategies for Learning Questionnaire was selected because the researcher believed it had practical application. As different learning strategies may be required for success in various college subjects, the MSLQ was deemed an ideal instrument to use. The instrument was able to assess the learning strategies that were most effective among developmental math students.

The following eight scales were selected for inclusion in the present study: Rehearsal, Elaboration, Organization, Metacognitive Self-Regulation, Time and Study Management, Effort Regulation, Peer Learning, and Help Seeking. All but one (Critical Thinking) of the learning strategies scales were included in the present study. Critical thinking was deemed to be more a skill than a learning strategy, so it was excluded from the study. The motivational variables were also eliminated from the study because math attitudes (perceived usefulness of math and math anxiety) serve the same purpose but are specific to the subject being studied. The two math attitudes are very similar to two of the MSLQ motivation scales (Task Value and Test Anxiety). The number of questions was reduced from a possible 45 (from the eight scales) to 37. Items that were excluded did not seem particularly relevant to math or were repetitive. Wording for 26 items was changed to make them more relevant to math. Modifications to the MSLQ scale are available in Appendix G. Table 4 shows the scales used for the study and the number of items on each scale.

A reliability analysis (Cronbach's Alpha) was conducted for each of the scales. Three of the eight subscales had reliabilities of .7 or above which were acceptable levels; however, several subscales failed to reach that level. To attain higher reliability indices, some of the subscales were combined into similar categories. Elaboration, organization, and rehearsal were combined and reclassified as Study Skills. The reliability index for that subscale increased to .839, well within acceptable levels. The Peer Learning and Help Seeking variables were combined since both concerned help seeking behaviors, and the new scale was renamed Peer Help. Its reliability was calculated to be .678 with all seven items included. One item, *"Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone,"* did not adequately measure the construct and was, therefore, excluded from the Peer Help scale which resulted in a reliability score of .716. Results from the reliability tests are presented in Table 5. The five subscales used in the analyses each achieved an acceptable level of reliability.

Table 4
Motivated Strategies for Learning Questionnaire - Modified Scales

Scale	Description	Number of Items
Rehearsal	Learning strategy involving memorization, recitation, and repetition	3
Elaboration	Strategy that integrates and connects new information with prior knowledge (i.e., paraphrasing, summarizing)	3
Organization	Outlining and selecting main ideas and organizing course materials	3
Metacognitive Self-Regulation	Being aware of (planning and monitoring) and monitoring (regulating) cognitive processes (i.e., self-testing, comprehension checks)	9
Environment (Time and Study Management)	Managing the study environment (i.e., minimizing distractions, using study time effectively)	8
Effort Regulation	Controlling attention and effort to remain focused on learning	4
Peer Learning	Collaborating with peers to enhance learning	3
Help Seeking	Requesting help from peers and instructors when necessary	4
TOTAL		37

Table 5
Reliability Statistics - Cronbach's Alpha

Scale	Cronbach's Alpha	Number of Items
Metacognitive Self Regulation	.771	9
Environment (Time & Study Management)	.751	8
Effort Regulation	.710	4
Study Skills (Rehearsal, Elaboration, Organization)	.839	9
Peer Help (Peer Learning & Help Seeking)	.716	6

Self-regulated learning consisted of 37 items and 5 subscales. The subscales were Metacognitive Self-regulation, Environment, Effort Regulation, Study Skills, and Peer Help. Subscale scores were calculated based on the mean of item responses for each respective subscale. An overall mean for self-regulated learning was also calculated. Responses ranged from 1 (low self-regulatory strategy usage) to 7 (high strategy usage).

Fennema-Sherman Math Attitudes Scales.

The attitudinal math variables, usefulness of math and math anxiety, were measured using two of nine subscales of the Fennema-Sherman Mathematics Attitudes Scales. Approval to use the survey was granted by Dr. Elizabeth Fennema (per email communication presented in Appendix F). The instrument was developed in 1976 and has been used extensively over the past 30 years to assess math attitudes (Fennema & Sherman, 1976). The instrument consists of nine scales including: Attitude Towards Success in Mathematics; Mathematics as a Male Domain; Mother, Father, and Teacher Attitudes Scales; Confidence in Learning Mathematics; Math Anxiety Scale; Effectance Motivation in Mathematics Scale; and Usefulness of Mathematics Scale. After an initial pilot test (used for item selection) involving 367 high school students, the 173 original items were pared down to 108, with twelve items per subscale for the final version (Fennema & Sherman, 1976). Fennema and Sherman (1976) reported split-half reliabilities for the nine scales ranging from .86 to .93.

For the purpose of this study, only the Math Anxiety and Usefulness of Mathematics subscales were used. Split-half reliabilities (from the original pilot) of the Usefulness of Mathematics Scale and the Math Anxiety Scale were .88 and .89, respectively (Fennema & Sherman, 1976). Responses are assigned a weighted value of 1 to 5 points, with higher point values representing more positive attitudes toward math. Half of the items on each scale are positively worded, while the other half are negatively worded and must, therefore, be reverse coded. Individual subscale scores can range from 12-60 with higher cumulative scores indicating better attitudes toward mathematics. Composite scores are used for analyses with higher composite scores representing lower math anxiety and greater perceived usefulness of math, respectively.

The Math Anxiety subscale measures “feelings of anxiety, dread, nervousness, and associated bodily symptoms related to doing mathematics” (Fennema & Sherman, 1976, p. 4). Sample items include: “I usually have been at ease in math classes” and “My mind goes blank and I am unable to think clearly when working mathematics” (Fennema & Sherman, 1976, p. 28). The Usefulness of Mathematics Scale is designed to measure beliefs about the usefulness and relevance of mathematics to students’ educational, career, and daily activities (Fennema & Sherman, 1976). Sample items from this scale include: “Mathematics is of no relevance to my life” and “I will use math in many ways as an adult.” For the present study, the only modification to the scale was to change the words “high school” to “college” to accurately represent participants’ educational status.

Final instrument.

All of the demographic, attitudinal, and self-regulatory items were compiled by the researcher into one instrument, so participants completed one survey that included all of the self-reported variables. A copy of the instrument used for the study can be found in Appendix E. The survey was administered during the second half of the semester and prior to the withdrawal deadline. This timing allowed students ample opportunity to apply self-regulatory strategies. Participating instructors selected a time to administer the survey to their respective classes. They read the instructions to the class, and students who chose to participate completed the survey and signed a consent form. Participants returned completed surveys to their math instructor who forwarded them to the math department. The researcher collected the surveys and consent forms from the math department after the summer and fall terms. Copies of the consent forms were submitted to the College's Institutional Research office since the study involved the release of student records. The Institutional Research office provided final grades for study participants.

Variables

Independent variables.

The independent variables included demographic, academic, attitudinal, and self-regulatory factors. The demographic and academic variables were the only independent variables involved in research question one. For the second research question, the independent variables included demographic and academic factors as well as attitudes toward math, specifically math anxiety and usefulness of math. For all subsequent analyses, demographic, academic, attitudinal, and self-regulatory factors served as independent variables. The variables were operationalized as described in the section on Data Sources & Instrumentation.

Dependent variables.

The first research question had several dependent variables including math attitudes, self-regulatory strategy usage, and course outcomes. Academic self-regulation served as the dependent variable for the second research question. The dependent variables for the last two research questions involved course outcomes in developmental math. For research question three, the dependent variable was course grades (of students who completed the course). Persistence, or course completion, served as the dependent variable in the final analysis. Table 6 presents a summary of the independent and dependent variables used in the analyses.

Table 6
Description of Independent (IV) and Dependent (DV) Variables for Research Questions (RQ)

Variable	Type	Description	RQ1	RQ2	RQ3	RQ4
Gender	Dichotomous	Male/Female (Male as reference group)	IV	IV	IV	IV
Ethnicity	Categorical	White, Black, Hispanic, Other	IV	IV	IV	IV
Age	Interval	Student's age as reported	IV	IV	IV	IV
Enrollment Status	Dichotomous	Full or part-time enrollment (Full-time as reference group)	IV	IV	IV	IV
Hours Worked	Interval	Hours worked per week	IV	IV	IV	IV
Marital Status	Categorical	Single, married, divorced/ separated	IV	IV	IV	IV
Dependents	Dichotomous	Dependents/No Dependents (No Dependents as reference group)	IV	IV	IV	IV
Parent Education Level	Dichotomous	If either parent has a bachelor's degree or higher, the student is considered continuing generation (Continuing generation as reference group)	IV	IV	IV	IV
Math Preparation	Dichotomous	Indicates whether the student required prior remediation in math (Lower level developmental math as reference group)	IV	IV	IV	IV
Academic Preparation	Categorical	Number of academic deficiencies by subject area: 1) math only, 2) math and either reading or writing, 3) math, reading, and writing	IV	IV	IV	IV
		Attitudes Toward Math				
Usefulness of Math	Ordinal	Beliefs about relevance of math	DV	IV	IV	IV

Math Anxiety	Ordinal	Feelings of anxiety related to math	DV	IV	IV	IV
		Self-regulated Learning				
Study Skills	Ordinal	Study strategies involving review and memorization, relating material to other subjects/knowledge, and organizing/outlining important material	DV	DV	IV	IV
Metacognitive Self-Regulation	Ordinal	Perceived ability to plan and assess one's learning and to adapt accordingly	DV	DV	IV	IV
Environmental Management	Ordinal	Ability to regulate one's learning environment (i.e., study/time management)	DV	DV	IV	IV
Effort Regulation	Ordinal	Ability to focus on coursework despite lack of interest or distractions	DV	DV	IV	IV
Peer Help	Ordinal	Willingness to seek help from others and learn from peer interactions	DV	DV	IV	IV
Self-regulated Learning Composite	Ordinal	Composite of all self-regulated learning scales	DV	DV	IV	IV
		Course Outcomes				
Course Grades	Ordinal	Final grade in developmental math course	DV	N/A	DV	N/A
Course Persistence	Dichotomous	Completion of developmental math course	DV	N/A	N/A	DV

Data Analyses

The purpose of the study was to determine attitudinal and self-regulatory factors that influence academic success in developmental math courses. Therefore, a quantitative research design was used. Data collected from the self-report surveys and institutional records were input into SPSS 14.0 for analysis, and several descriptive and inferential statistical analyses were conducted to answer the research questions.

Data input and coding of variables.

After surveys were collected, the researcher input responses into SPSS for analysis. When inputting data collected from the surveys, several decisions had to be made regarding how to handle unique responses and missing data. When entering data, the variables below were treated as follows:

- *Self-regulatory Items*: These items were coded on a scale of 1-7 (not at all true of me to very true of me), as reported by the student, with higher scores representing greater usage of self-regulatory strategies. Each item was labeled based on its subscale (i.e., item number six measuring effort regulation was labeled "EFF6") in order to easily distinguish the respective subscale.
- *Math Attitudes*: These items were coded on a scale of 1-5 (strongly agree to strongly disagree), as reported by the student, with higher scores representing more positive attitudes toward math. Items were labeled based on their respective subscale (i.e., item two on the scale measuring perceived usefulness of math was labeled MU2).
- *Gender*: The variable was dummy coded with 0 representing males and 1 representing females.
- *Ethnicity*: There were eight ethnic categories from which students could choose. The variable was dummy coded with 0 representing the participant's ethnicity and 1 representing each other ethnicity. For participants who marked multiple boxes for ethnicity, the data were coded as Multiracial. For the analyses, four of the ethnic categories (American Indian or Alaska Native, Asian, Native Hawaiian or Other

Pacific Islander, and Multiracial) were collapsed into "Other" due to low numbers of participants. The ethnic categories used in the analyses were White, Black, Hispanic, and Other. Each category was recoded (0=White, 1=Black, 2=Hispanic, 3=Other).

- *Enrollment Status*: This variable was dummy coded with 0 representing full-time status and 1 representing part-time status.
- *Employment*: This variable was input based on the student's response to the question. For participants who entered a range of hours worked per week, the lowest number other than zero was used (i.e., a response of "0-5" was entered as "1").
- *Age*: The student's response to this item was entered as reported.
- *Marital Status*: This categorical variable was dummy coded as follows: single was coded 0, married was coded 1, and divorced/separated was coded 2. Participants who checked both married and divorced/separated were coded as 2 (divorced/separated), assuming the participant was married but separated.
- *Dependents*: This item was originally entered based on the participant's response (number of dependents). However, the researcher created a new variable to represent whether or not participants had children. The new variable was dummy coded with 0 representing students who do not have dependents and 1 representing participants with dependents.
- *Parent Education Level*: If either parent had earned a bachelor's degree or higher, the data were coded as continuing generation (0). If parent education level was below a bachelor's degree, the data were coded as first generation (1). (For participants who marked "Unknown" for one parent but who provided the level of education for the

other parent, the data were coded based on the parent for whom the data were provided.)

- *Math Preparation*: For students who had completed a lower level developmental math course, the data were coded 0. A 1 represented participants who did not need a lower level developmental math course. In many cases, students marked “Don’t Know,” in which case the data were coded as missing.
- *Academic Preparation*: This variable represented the subjects in which students were underprepared. Two variables were input originally—one for reading and one for writing. The variables were dummy coded with 0 representing the subject in which the participant was deficient and 1 representing college readiness in that subject. A new variable was later created to categorize the student by academic preparation. Three levels of academic preparation were used for the study: math only (one deficiency); math and reading or writing (two deficiencies); and math, reading, and writing (three deficiencies). Participants deficient only in math were coded as 0, those deficient in two subjects were coded as 1, and those deficient in three subjects were coded as 2.
- *Final Course Grades*: Grades were entered as A, B, C, D, F, or W.
- *Course Persistence*: This variable was coded 0 for persistence (completed the course with a grade of A-F) and 1 for withdrawal.

If no response was provided, duplicate responses were selected (for Likert scales), or responses were illegible, the item was coded as “missing” by entering a value of 99 and defining the value as such in SPSS. After data were entered into SPSS, the researcher reviewed the data for accuracy and made the necessary corrections. Several items on the Motivated Strategies for

Learning and Fennema-Sherman Math Attitudes Scales required recoding. Items that were reverse coded (items 1, 4, 16, 20, 23, 34, and 37 from the MSLQ section and items 3, 4, 6, 7, 9, 12, 15, 16, 19, 20, 21, and 22 from the Fennema-Sherman Math Attitudes section) were recoded so that higher scores represented more positive usage of learning strategies and attitudes toward math. Frequencies were run and results were reviewed for data integrity. All variables were within the appropriate range and were deemed valid. Several variables were created using the existing data, and those are presented in Table 7.

Descriptive statistics.

Descriptive statistics were run for each of the independent and dependent variables. Frequency distributions were calculated for categorical variables while range, mean, and standard deviation were computed for interval variables that represented demographic characteristics (age and hours worked per week). Means and standard deviations were also calculated for math attitudes, self-regulated learning, and math course outcomes. Based on the descriptive statistics, the study participants are described in detail in the following sections.

***Study participants*.**

The sample consisted of 376 students who were enrolled in developmental math courses during summer and fall 2009. About 70% of the participants were enrolled in Fundamentals of Algebra as compared with 30% who were enrolled in Contemporary Basic Math, the pre-cursor to Fundamentals of Algebra. Slightly over half of participants, 54.5%, were enrolled in a daytime course while the remaining 45.5% were enrolled in an evening course.

Table 7
Description of Variables that Were Created

New Variable	Description
Ethnicity	A categorical variable was created to collapse eight ethnic categories into four (White, Black, Hispanic, and Other). "Other" included American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and multiracial.
Dependents	A dichotomous variable was created to measure whether students had dependents or not.
Academic Preparation	A categorical variable was created to represent the number of academic deficiencies.
Perceived Usefulness of Math	Mean score of all items representing Usefulness of Math.
Math Anxiety	Mean score of all items representing Math Anxiety.
Metacognitive Self-regulation	Mean score for all items representing metacognitive self-regulation.
Environment	Mean score for all items representing environmental strategies.
Effort Regulation	Mean score for all items representing effort regulation.
Study Skills	Mean score for all items representing study skills.
Peer Help	Mean score for all items representing peer help.
Self-regulated Learning	Mean score of all items representing self-regulated learning strategies.

As demonstrated in Table 8, demographic characteristics of the participants were consistent with the college's student population in terms of gender, age, and enrollment status. Approximately two-thirds (62.7%) of participants were female, compared to 37.3% who were male. Over half of study participants were between the ages of 18-22, 22.7% were between 23 and 29, and 21.6% were 30 or older. Ages of participants ranged from 18-63 with the mean age being 25. The majority of participants, 61.5%, attended college full-time while the remaining 38.5% were enrolled half-time or less. Study participants differed somewhat from the college student body in terms of ethnicity. Slightly over 60% of participants were white, 14.7% were

Black, 11.5% were Latino, 5.1% were Multiracial, 4% were American Indian, 3% were Asian or Pacific Islander, and 0.8% were Other. For the purpose of the study, the categories of American Indian, Asian/Pacific Islander, Multiracial, and Other were combined into one category (Other Ethnicity). The percentage of students of color was higher among participants of the study than the overall student body. About 40% of study participants were students of color, compared to 29% of the student body. The higher percentage of students of color in the study was consistent with the participation rates in developmental education as identified in the literature (Crane, McKay, & Poziemski, 2002; McCabe, 2000; NCES, 2000).

Table 8
Demographic Characteristics of Participants Compared to Student Body

Variable	Demographic Characteristic	Study Participants	College Student Body
Gender[a]	Female	62.7%	58.2%
	Male	37.3%	41.6%
Ethnicity[a]	Caucasian	61.1%	71.7%
	Black	14.7%	10.0%
	Hispanic	11.5%	6.1%
	Other Ethnicity	12.8%	12.2%
Age[a]	Under 18	N/A	5.2%
	18-22	55.7%	52.5%
	23-29	22.7%	20.3%
	30-49	19.2%	18.6%
	50+	2.4%	3.4%
Enrollment Status[b]	Full-time	61.5%	58%
	Part-time	38.5%	42%

[a]Spring 2009 Quick Facts. [b]Research Office, 2007.

Approximately 75% of study participants were employed. Weekly hours worked ranged from 0-80 with a mean of 23.41 and a median of 25. Three-quarters of the students reported being single, compared to 18% married and 7.2% divorced/separated. About 40% of participants reported having dependents. Nearly two-thirds of participants were from households in which neither parent had earned a bachelor's degree. In terms of their preparation for college, over half (56.1%) reported having taken a lower level developmental math course, while 17.2% and 27.6%, respectively, reported the need for developmental reading and developmental writing coursework. About one-third of the students required remediation in at least one other subject. (Many students did not know whether they needed additional remediation in math, reading, or writing.) Tables 9 and 10 display the demographic and academic characteristics of participants.

Table 9
Demographic and Academic Characteristics of Study Participants

Independent Variable	Demographic/Academic Characteristic	N	Number	Valid Percent
Marital Status	Single	373	279	74.8%
	Married		67	18%
	Divorced/Separated		27	7.2%
Dependents	Have Dependents	331	138	41.7%
	No Dependents		193	58.3%
Parent Education	Continuing Generation	350	129	36.9%
	First Generation		221	63.1%
Academic Preparation	Math Only	305	215	70.5%
	Two Deficiencies (math and reading or writing)		45	14.8%
	Three Deficiencies (math, reading and writing)		45	14.8%
Math Preparation	Lower Level Math Required	294	165	56.1%
	Lower Level Math Not Required		129	43.9%

Table 10
Measures of Central Tendency for Hours Worked and Age

Independent Variable	N	Minimum	Maximum	Median	Mean	Standard Deviation
Hours Worked	351	0	80	25	23.41	17.76
Age	370	18	63	21	24.96	8.8

Math attitudes.

This variable measured students' attitudes toward math in two areas: math anxiety and perceived usefulness of math. Math anxiety measured students' physiological, physical, psychological response to math. Usefulness of math measured students' perceptions of math's relevance to their lives. Attitudes toward math were measured on a five point scale with higher scores representing more positive attitudes toward math. As displayed in Table 11, the mean for perceived usefulness of math was 3.63, indicating that participants perceived math as moderately useful. The mean for math anxiety was lower at 2.90, signifying that study participants were neither very anxious toward math nor very comfortable with it. Although students may experience some adverse reactions toward math, math anxiety does not appear to be particularly intense among this sample.

Table 11
Mean and Standard Deviation for Math Attitudes

Math Attitudes	Attitudes Toward Math	Mean (SD)
Math Attitudes	Perceived Usefulness of Math	3.63 (.86)
	Math Anxiety	2.90 (.87)

Note. N equals 376. Math attitudes are based on a five point scale with 5 representing strongly agree and 1 representing strongly disagree.

Self-regulated learning.

Self-regulated learning measured participants' ability to control cognitive, metacognitive, and behavioral aspects of learning, and as such, was an indicator of the degree to which participants were actively involved in the learning process. Self-regulated learning indices were measured on a seven point scale with higher scores representing higher levels of self-regulated learning. As displayed in Table 12, mean responses were highest for the effort regulation and environmental management subscales, at 5.19 and 5.10, respectively. The scores indicate that participants were able to regulate their effort and manage their environment relatively well. Metacognitive self-regulation and study skills were the next highest, with means of 4.64 and 4.45, respectively. The results signify that students engage in metacognitive self-regulation and use study strategies but that they could do so more consistently. Peer help had the lowest mean at 3.46. Students' responses to items on the peer help scale were primarily neutral, signifying that they were not very likely to request help from others. Overall, the mean for self-regulated learning was 4.56. This indicates that although students engaged in self-regulatory behaviors, there is considerable room for improvement. Students would likely benefit from increasing their self-regulatory strategy usage.

Final course grades.

Final course grades, the dependent variable for research question III, represented the grade earned by the participant in his/her developmental math course. Final course grades were not available for all students as the cooperating institution, due to limited resources, was not able to provide grades for each student. However, grades were collected for 217 of the participants. Of the participants for whom grades were available, 88 (40.6%) earned an A, 44 (20.3%) earned a B, 42 (19.4%) earned a C, 19 (8.8%) earned a D, and 16 (7.4%) earned an F. The other 8 (3.7%) participants withdrew and, therefore, received a grade of W. Approximately 80% of students successfully completed the course. Table 13 displays the mean for course grades while Table 14 shows the frequency of final grades earned.

Course persistence.

Course persistence measured whether students completed their developmental math course or withdrew. Students who completed the course were considered to have persisted. Of the 217 participants for whom grades were available, nearly all of them completed the course. 209 (96.3%) students completed the course and only 8 (3.7%) withdrew.

Table 12
Means and Standard Deviations for Self-regulated Learning Scales

Self-regulated Learning	Self-regulated Learning Subscale	Mean (SD) (7 point scale)
Self-regulated Learning	Metacognitive Self-regulation	4.64 (1.00)
	Environment	5.10 (1.04)
	Effort	5.19 (1.23)
	Study Skills	4.45 (1.18)
	Peer Help	3.46 (1.18)
	Composite (Average)	4.56 (.86)

Note. N equals 376. Self-regulated learning is measured on a seven point scale with higher values representing greater learning strategy usage.

Table 13
Mean and Standard Deviation for Course Grades

Dependent Variable	Mean Grade (SD)
Course Grades	2.81 (1.28)

Note: N equals 209. (Does not include students who withdrew.) Course grades are based on a 4 point scale (4=A).

Table 14
Frequency of Final Grades Earned

Final Grade	N	Valid Percent
A	88	40.4%
B	44	20.3%
C	42	19.4%
D	19	8.8%
F	16	7.4%
W (Withdraw)	8	3.7%
Total	217	100%

Inferential statistics.

Inferential statistics including chi square analyses, analyses of variance, t-tests, correlation analyses, and multiple/logistic regression analyses were conducted to answer each of the research questions. Correlation analyses were conducted for ordinal and interval variables, including math attitudes and self-regulated learning, to check for relationships between variables. Independent samples t-tests, analyses of variance, and correlation analyses were conducted to answer the first research question. Since regression analysis is used for prediction purposes, (Gravetter & Wallnau, 2005), multiple and logistic regression analyses were used to answer research questions two through four.

Chi square analyses to compare study sample with sample for whom grades were available.

Due to limited resources, the cooperating institution was only able to provide final grades for students who provided a student identification number. (This only affected students who participated in the fall semester as final grades were provided for all students who participated in the summer term.) There were 217 participants whose final grades were provided. Chi square analyses were conducted to ensure that the sample for whom grades were available was similar to the overall sample. Chi square analyses revealed that both samples were similar in terms of gender, race, enrollment status, marital status, dependents, course level, parent education, academic preparation, and math preparation. The samples differed in two areas: campus attended, χ^2 (1) = 6.298, p = .012, and daytime/evening enrollment, χ^2 (1) = 7.076, p = .008. Cramer's V was .129 and .137, respectively, indicating a moderate effect size (Cohen, 1998). Since neither of the two factors was included in any of the statistical analyses, the researcher concluded that the samples were sufficiently similar. Therefore, research questions related to course outcomes were analyzed using the subset of participants for whom a final grade was available. Results of the chi square analyses are provided in Appendix H.

Research question I: Differences in math attitudes, self-regulated learning and math course outcomes based on background variables.

The first research question investigated the demographic variables that were associated with math attitudes, self-regulated learning, and developmental math course persistence. To answer this question, several types of analyses were conducted. Independent samples t-tests were conducted to determine if differences existed in self-regulatory strategy usage, math attitudes, and course grades based on gender, parent education, dependents, enrollment status, and math preparation. To determine differences based on ethnicity, marital status, and academic preparation, one way analyses of variance (ANOVA) were conducted. When significant differences were found, Scheffe post-hoc tests were conducted to determine the groups that differed significantly. Correlation analyses were conducted to determine if differences existed in self-regulatory strategy usage, math attitudes, and course grades based on the interval variables, age and hours worked.

Research question II: Attitudinal factors that contribute to self-regulated learning.

This research question examined the attitudinal factors that contribute to self-regulated learning among developmental math students after controlling for demographic and academic characteristics. To answer this research question, an enter-wise multiple regression analysis was conducted with self-regulated learning as the dependent variable. The mean of responses to all self-regulated learning items was used as the dependent variable (SRLAvg). In the original MSLQ, composite scores are used for the analyses; however, for this study, the mean was used in order to account for items that had missing scores. Three blocks were used in this analysis.

Demographic variables were entered into the first block, followed by academic variables and then math attitudes. Demographic variables included in the first block were gender, ethnicity, parent education, marital status, dependents, age, and hours worked per week. The academic variables in block two were enrollment status, math preparation, and academic preparation. The third block was comprised of two variables: math anxiety and perceived usefulness of math. The mean of items related to each of the math attitudes scales was used in the analysis. Fennema-Sherman used composite scores for their studies; however, mean scores were used in this analysis to account for missing data.

Tolerance levels were calculated to test for correlations among independent variables included in the regression analysis. The majority of independent variables had tolerance levels between .727 and .906. Three variables had tolerance levels below .7, including age at .649, marital status (married) at .571, and dependents at .559. Since a tolerance level of 1 indicates that an independent variable is not correlated with the other independent variables and because there is not agreement on what constitutes small tolerance (Pedhazur, 1997), the researcher concluded that the results satisfied the test for collinearity.

Research question III: Influence of self-regulated learning on math course outcomes.

It is important to consider the relationship that student characteristics, math attitudes, and self-regulated learning have with developmental math course outcomes. Although grades of developmental courses are not calculated in the student's grade point average at the participating institution, successful completion of the developmental course is required before students can advance to the next level. It was, therefore, necessary to consider course outcomes. The final two research questions, which concerned the predictive nature of the demographic, academic, attitudinal, and self-regulatory variables on final grades and course persistence, addressed course outcomes. The findings from these analyses enhance our understanding about whether developmental math students who earn higher grades and/or who persist throughout the semester have better attitudes toward math or are more likely to be self-regulated learners.

Regression analyses were conducted for each of the two remaining research questions. To answer the third research question, an enter-wise multiple regression analysis was conducted. The regression analysis consisted of four blocks. The blocks included demographic variables, followed by academic variables, math attitudes, and self-regulated learning. Mean scores for each subscale (math attitudes and self-regulated learning) were used in the analysis. Since this research question involved the demographic, attitudinal, and self-regulatory factors that contribute to success in developmental math courses, course grades served as the dependent variable; however, only students who completed the course (earned a grade of A, B, C, D, or F) were included in the analysis. Students who withdrew were excluded. Most of the participants earned an A in the course, and over three quarters passed the course with a C or higher. The frequency of final grades earned is presented in Table 14.

Results of the regression analysis were examined for collinearity. Tolerance levels for the self-regulated learning variables were between .0001 - .004. The low numbers were indicative of collinearity among the independent variables (Pedhazur, 1997). Since the self-regulated learning variables broadly measure the same construct, the researcher decided to use the average (composite) self-regulated learning scores rather than the subscales. Given the strong correlations among the overall self-regulatory learning scale and the subscales, it is reasonable to analyze the overall scale scores rather than the subscales. Therefore, the regression analysis was conducted a second time using only the composite self-regulatory strategy scale. The collinearity diagnostics improved considerably. Tolerance statistics ranged from .572 to

.930, with most results being in the 0.7 - 0.9 range. The researcher concluded that the results were satisfactory.

Research question IV: Influence of self-regulated learning on math course persistence.

The final research question also concerned developmental math course outcomes. Specifically, it addressed whether demographic characteristics, math attitudes, and self-directed learning contributed to course persistence (completion of the course). Because persistence is a dichotomous variable, it was dummy coded. Students who completed the course were coded as 1, whereas students who withdrew, the reference group, were coded as 0. To answer this question, the independent variables for the logistic regression analysis were set up identically to the previous research question with demographic, academic, attitudinal, and self-regulated learning in separate blocks. The only difference between the two analyses was the change in the dependent variable that measured developmental math course persistence. As depicted in Table 14, less than four percent of participants withdrew from their developmental math course. Therefore, there was not sufficient data to conduct this analysis.

Results of the analyses of each research question are presented in Chapter 4. A discussion of the results is presented in Chapter 5.

Results

The purpose of this study was to investigate the relationship among math attitudes, self-regulated learning, and academic success in developmental math courses among community college students. Attitudes toward math (specifically perceived usefulness of math and math anxiety) were hypothesized to influence self-regulated learning and developmental math course outcomes. Self-regulated learning, the ability to control cognitive, metacognitive, and behavioral aspects of learning (Zimmerman, 1990), was expected to influence the academic performance of developmental math students. The research questions examined the influence of attitudinal factors on self-regulated learning and the extent to which self-regulated learning and math attitudes contributed to academic success (final course grades) in developmental math courses. This chapter presents the findings from each of the research questions. The results of the analyses are presented below.

Research question I: Differences in math attitudes, self-regulated learning, and course outcomes based on demographic and academic variables

Research question I examined differences in self-regulatory strategy usage, math attitudes, and final course grades based on demographic and academic variables. Course persistence could not be assessed due to the low number of students who withdrew. Findings for each of the background variables are presented below.

Gender.

In terms of overall self-regulatory strategy usage, the mean for females was 4.68 and the mean for males was 4.37 on a scale of 1-7. This indicates that females were fairly likely to use self-regulatory strategies. Although males were somewhat less likely to use self-regulatory strategies, both groups could use the strategies more regularly. Results from independent samples t-tests indicated that gender differences existed with regard to several self-regulatory strategies including environmental management, effort regulation, and self-regulatory strategy usage overall. Females reported significantly higher strategy usage overall and with regard to environmental management and effort regulation than males. As displayed in Table 16, the means for math attitudes of males and females were similar. While both groups perceived math as somewhat useful, neither group had strong feelings about math anxiety. Although attitudes toward math did not differ significantly based on gender, significant differences in final course

Table 15
Independent Samples T-tests: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Gender

			Mean (SD)		
Dependent Variable	Sig.	t	Female	Male	Effect Size[a]
Perceived Usefulness of Math	.258	-1.245	3.67 (.87)	3.56 (.82)	
Math Anxiety	.805	1.049	2.87 (.88)	2.96 (.86)	
Metacognitive Self-regulation	.178	-1.901	4.72 (.95)	4.52 (1.06)	
Environmental Management	**.001**	**-5.258**	**5.31 (1.04)**	**4.77 (.92)**	**.55 Moderate**
Effort Regulation	**.001**	**-3.754**	**5.37 (1.21)**	**4.89 (1.20)**	**.40 Small**
Study Skills	.707	-1.649	4.54 (1.14)	4.33 (1.21)	
Peer Help	.919	-1.838	3.55 (1.17)	3.32 (1.57)	
SRL Composite	**.001**	**-3.503**	**4.68 (.81)**	**4.37 (.87)**	**.38 Small**
Final Course Grades	**.001**	**-3.844**	**3.08 (1.16)**	**2.38 (1.35)**	**.56 Large**

Note. N equals 235 (female) and 140 (male) except for Final Course Grades for which N equals 129 (female) and 80 (male). Degrees of freedom equal 373 except for Course Grades which equal 148.7. Bold-faced type denotes significant relationship.
[a]Huck and Cormier, 1996.

grades did exist with females earning considerably higher grades than males in developmental math. The mean for course grades was 3.08 on a four point scale (1.16 standard deviation) for females and 2.38 (1.35 standard deviation) for males. Collectively, females were likely to earn a B average, compared to a C average for males. The large effect size indicates that female participants performed substantially better in developmental math than males.

Ethnicity.

Based on ethnicity, self-regulatory strategy usage and math anxiety resulted in the same patterns as seen in the overall study sample. As presented in Table 16, means for effort regulation and environmental management were highest, followed by metacognitive self-regulation, study skills, and peer help. Means for perceived usefulness of math ranged from 3.57 (Black) to 3.82 (Hispanic), indicating that students perceived math as somewhat useful. Regarding math anxiety, means ranged from 2.83 (Black) to 3.09 (Hispanic). Results were mid-range on the scale signifying that participants experienced average levels of math anxiety. However, differences based on ethnicity were insignificant, as determined by one-way analyses of variance. Interestingly, ethnic differences were not found in relation to course grades, either, despite the fact that students of color are more apt to require remediation than white students (Crane, McKay, & Poziemski, 2002; McCabe, 2000; NCES, 2000).

Hours worked.

As presented in Table 17, results from correlation analyses revealed that number of hours worked per week was not significantly related to math attitudes, self-regulated learning, or math course grades. Although it would seem that the more hours students work, the less time they would have to devote to their studies, the results imply that that is not the case.

Table 16
ANOVA: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Ethnicity

Dependent Variable	Ethnicity	Mean (SD)	F	Sig.
Usefulness of Math	White	3.58 (.88)	1.390	.246
	Black	3.57 (.88)		
	Hispanic	3.82 (.80)		
	Other	3.74 (.77)		
Math Anxiety	White	2.85 (.84)	1.340	.261
	Black	2.83 (.96)		
	Hispanic	3.09 (.93)		
	Other	3.02 (.83)		
Metacognitive Self-regulation	White	4.57 (.97)	1.455	.226
	Black	4.75 (1.01)		
	Hispanic	4.88 (1.15)		
	Other	4.63 (1.04)		
Environmental Management	White	5.06 (1.04)	.730	.535
	Black	5.11 (.94)		
	Hispanic	5.32 (1.12)		
	Other	5.08 (1.05)		
Effort Regulation	White	5.17 (1.19)	1.185	.315
	Black	5.11 (1.36)		
	Hispanic	5.50 (1.33)		
	Other	5.05 (1.17)		
Study Skills	White	4.35 (1.18)	1.492	.216
	Black	4.69 (1.04)		
	Hispanic	4.57 (1.42)		
	Other	4.52 (1.02)		
Peer Help	White	3.40 (1.18)	.711	.546
	Black	3.65 (1.04)		
	Hispanic	3.46 (1.42)		
	Other	3.53 (1.02)		
Self-regulated Learning (Composite)	White	4.50 (.84)	1.261	.288
	Black	4.67 (.79)		
	Hispanic	4.73 (1.05)		
	Other	4.56 (.83)		
Final Course Grades	White	2.98 (1.18)	2.386	.070
	Black	2.36 (1.47)		
	Hispanic	2.50 (1.47)		
	Other	2.74 (1.29)		

Note: N equals 375 and degrees of freedom are 3, 371 except for final course grades for which N equals 209 and degrees of freedom are 3, 205.

Age.

Age was not significantly related to math attitudes; however, it was significantly related to both self-regulatory strategy usage and final course grades. As displayed in Table 17, age was significantly related to metacognitive self-regulation, environmental management, effort regulation, and study skills. Effect sizes were small except for environmental management which represented a moderate effect size. Age was also significantly and moderately correlated with final course grades. All relationships were positive, indicating that older students had higher levels of self-regulatory strategy usage and earned higher grades than their younger peers. The strength of the relationships was most substantial with regard to environmental management and course grades.

Parent education.

As shown in Table 18, first and continuing generation students ranked effort regulation and environmental management the highest among the self-regulated learning subscales. First and continuing generation students were somewhat likely to engage in effort regulation and environmental management but less likely to use other strategies. With regard to math attitudes, first generation students perceived math as relatively useful ($\overline{X}$=3.71) but reported middle-range responses to math anxiety ($\overline{X}$=2.96). Continuing generation students had lower scores in comparison on perceived usefulness of math and math anxiety ($\overline{X}$=3.47 and $\overline{X}$=2.69, respectively). Based on results of independent samples t-tests (presented in Table 19), parent education was significantly related only to math attitudes. It is notable that first generation students had more positive attitudes toward math than their peers whose parent(s) had earned at least a bachelor’s degree. The groups differed with regard to both math anxiety and perceived usefulness of math with first generation students perceiving math as more useful and

Table 17
Correlation Matrix: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Age and Hours Worked

Dependent Variable	Correlation Statistics	Hours Worked	Age	Effect Size[a]
Math Anxiety	Pearson Correlation	-.084	-.007	
	Sig (2-tailed)	.116	.898	
	N	351	370	
Perceived Usefulness of Math	Pearson Correlation	.036	.063	
	Sig (2-tailed)	.500	.224	
	N	351	370	
Metacognitive Self-regulation	Pearson Correlation	.049	**.271**	Small
	Sig (2-tailed)	.364	.000	
	N	351	370	
Environmental Management	Pearson Correlation	.006	**.311**	Moderate
	Sig (2-tailed)	.913	.000	
	N	351	370	
Effort Regulation	Pearson Correlation	-.013	**.286**	Small
	Sig (2-tailed)	.812	.000	
	N	351	370	
Study Skills	Pearson Correlation	.093	**.204**	Small
	Sig (2-tailed)	.082	.000	
	N	351	370	
Peer Help	Pearson Correlation	-.005	.031	
	Sig (2-tailed)	.930	.557	
	N	351	370	
Self-regulation (Comp)	Pearson Correlation	.043	**.285**	Small
	Sig (2-tailed)	.425	.000	
	N	351	370	
Final Course Grade	Pearson Correlation	.098	**.309**	Moderate
	Sig (2-tailed)	.173	.000	
	N	193	207	

Note. Bold-faced type denotes significant relationship.
[a] Cohen, 1998.

experiencing less anxiety toward math than continuing generation students. Although effect sizes were small, it is interesting to note that participants whose parents had less formal education had better attitudes toward math.

Table 18
Independent Samples T-tests: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Parent Education (First/Continuing Generation)

			Mean (SD)		
Dependent Variable	Sig.	t	First Generation	Continuing Generation	Effect Size[a]
Perceived Usefulness of Math	**.014**	**-2.472**	**3.71 (.85)**	**3.47 (.89)**	**.30 Small**
Math Anxiety	**.004**	**-2.893**	**2.96 (.87)**	**2.69 (.81)**	**.32 Small**
Metacognitive Self-regulation	.886	1.054	4.57 (1.01)	4.69 (.99)	
Environmental Management	.934	.891	5.05 (1.05)	5.15 (1.04)	
Effort Regulation	.201	.228	5.16 (1.26)	5.19 (1.20)	
Study Skills	.944	.453	4.41 (1.18)	4.47 (1.18)	
Peer Help	.106	1.604	3.39 (1.22)	3.59 (1.08)	
Self-regulated Learning (Comp)	.193	1.703	4.50 (.89)	4.61 (.81)	
Final Course Grades	.263	-.091	2.81 (1.34)	2.79 (1.20)	

Note. Degrees of freedom equal 348 except for Course Grade which is 188. N equals 221 (first generation) and 129 (continuing generation) except for Course Grade which is 122 (first generation) and 68 (continuing generation). Bold-faced type denotes significant relationship.
[a]Huck and Cormier, 1996.

Dependents.

As displayed in Table 19, students with dependents were more likely than those who did not have children to engage in effort regulation, environmental management, metacognitive self-regulation, and study skills. Students with dependents reported relatively high means in all self-regulated learning subscales except peer help. The mean for perceived usefulness of math was also relatively high among students with dependents. Students with dependents are among the most likely to effectively use self-regulatory strategies and to perceive math as useful. On the contrary, students who do not have dependents are among the least likely to use self-regulatory strategies or to have positive attitudes toward math. Differences existed between participants who had dependents and those who did not with regard to self-regulated learning and math attitudes but not final course grades. Students who had dependents were more likely than those

Table 19
Independent Samples T-tests: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Dependents

			Mean (SD)		
Dependent Variable	Sig.	t	Dependents	No Dependents	Effect Size[a]
Perceived Usefulness of Math	**.007**	**-2.724**	**3.80 (.88)**	**3.53 (.88)**	**.30 Small**
Math Anxiety	.712	-.369	2.91 (.88)	2.87 (.85)	
Metacognitive Self-regulation	**.001**	**-3.574**	**4.86 (.89)**	**4.48 (1.04)**	**.39 Small**
Environmental Management	**.001**	**-4.270**	**5.40 (1.00)**	**4.91 (1.05)**	**.48 Small**
Effort Regulation	**.001**	**-4.686**	**5.56 (1.17)**	**4.95 (1.20)**	**.52 Moderate**
Study Skills	**.001**	**-3.224**	**4.70 (1.13)**	**4.29 (1.17)**	**.36 Small**
Peer Help	.319	-.998	3.54 (1.11)	3.41 (1.17)	
Self-regulation (Composite)	**.001**	**-4.365**	**4.80 (.77)**	**4.40 (.87)**	**.48 Small**
Course Grade	.265	-1.117	2.99 (1.22)	2.78 (1.30)	

Note. N equals 138 (no dependents) and 193 (dependents) except for Course Grades for which N equals 79 (no dependents) and 109 (dependents). Degrees of freedom equal 329 except for Course Grades for which degrees of freedom equal 186. Bold-faced type denotes significant relationship.
[a]Huck and Cormier, 1996.

who did not to use metacognitive self-regulatory techniques, environmental management, effort regulation, and study skills. Likewise, students with dependents perceived math as more useful than participants who did not have children. Although effect sizes were small for all dependent variables (except effort regulation which was moderate), the results demonstrate that participants who have children are quite capable of regulating their learning and do so more regularly and consistently than participants who do not have children.

Marital status.

Students who were divorced/separated had the highest mean scores of participants in any category for effort regulation ($\bar{X}$=5.83), environmental management ($\bar{X}$=5.51), and metacognitive self-regulation ($\bar{X}$=5.12). Married students were not far behind with mean scores of 5.61, 5.43, and 5.0, respectively. Single students, on the other hand, used self-regulatory strategies less frequently. As displayed in Table 20, analysis of variance revealed small yet significant differences in self-regulatory strategy usage based on marital status. Metacognitive self-regulation, environmental management, effort regulation, study skills, and self-regulated learning (composite) differed based on marital status. Scheffe post-hoc tests revealed that, in all cases except for study skills, participants who were married and those who were divorced/separated were more likely than their single counterparts to engage in self-regulatory strategies. With regard to study skills, married students reported higher levels of study skills usage than single students but not divorced/separated students. In terms of math attitudes and course grades, means for each group were similar. Analyses of variance confirmed that significant differences were not present with regard to math attitudes or grades. Despite the differences in self-regulated learning, course grades did not differ significantly based on marital status.

Table 20
ANOVA: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Marital Status

Dependent Variable	Marital Status	F	Sig.	Mean (SD)	Effect Size[a]
Usefulness of Math	Single	1.846	.159	3.58 (.82)	
	Married			3.72 (.99)	
	Divorced/Separated			3.87 (.90)	
Math Anxiety	Single	.892	.411	2.88 (.82)	
	Married			2.87 (.97)	
	Divorced/Separated			3.11 (1.15)	
Metacognitive Self-regulation	**Single**	**10.289**	**.001**	**4.5 (1.02)**	**.24**
	Married			**5.0 (.91)**	**Small**
	Divorced/Separated			**5.12 (.77)**	
Environmental Management	**Single**	**7.306**	**.001**	**4.99 (1.02)**	**.20**
	Married			**5.43 (1.03)**	**Small**
	Divorced/Separated			**5.51 (1.07)**	
Effort Regulation	**Single**	**10.957**	**.001**	**5.02 (1.25)**	**.24**
	Married			**5.61 (1.09)**	**Small**
	Divorced/Separated			**5.83 (.89)**	
Study Skills	**Single**	**7.941**	**.001**	**4.31 (1.18)**	**.20**
	Married			**4.87 (1.09)**	**Small**
	Divorced/Separated			**4.84 (1.09)**	
Peer Help	Single	1.448	.236	3.39 (1.21)	
	Married			3.64 (1.07)	
	Divorced/Separated			3.61 (1.04)	
Self-regulated Learning (Composite)	**Single**	**11.990**	**.001**	**4.43 (.86)**	**.24**
	Married			**4.90 (.77)**	**Small**
	Divorced/Separated			**4.96 (.66)**	
Course Grade	Single	1.861	.158	2.71 (1.32)	
	Married			3.05 (1.14)	
	Divorced/Separated			3.19 (1.11)	

Note. N equals 279 (single), 67 (married), and 27 (divorced/separated) except for Course Grade for which N equals 155 (single), 38 (married), and 16 (divorced/separated). Degrees of freedom are 2, 370 for all variables except Course Grade for which degrees of freedom are 2, 206. Bold-faced type denotes significant relationship.
[a]Huck and Cormier, 1996.

Enrollment status.

Effort regulation was the most common self-regulatory strategy for both full-time and part-time students ($\bar{X}$=5.32 and $\bar{X}$=5.10, respectively), followed closely by environmental management ($\bar{X}$=5.22 and $\bar{X}$=5.04, respectively). Part-time and full-time students were relatively likely to engage in those self-regulatory strategies. Regardless of enrollment status, students appear to exert approximately the same level of self-directed learning. Perhaps as a result of having similar levels of self-regulation, differences in course grades did not exist. With regard to math attitudes, small yet significant differences existed between full- and part-time students.

Table 21
Independent Samples T-tests: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Enrollment Status

			Mean (SD)		
Dependent Variable	Sig.	t	Full-time	Part-time	Effect Size[a]
Perceived Usefulness of Math	**.016**	**-2.427**	**3.54 (.86)**	**3.76 (.84)**	**.26 Small**
Math Anxiety	**.035**	**2.115**	**2.97 (.85)**	**2.78 (.90)**	**.23 Small**
Metacognitive Self-regulation	.066	-1.842	4.56 (1.03)	4.75 (.95)	
Environmental Management	.105	-1.628	5.04 (1.02)	5.22 (1.05)	
Effort Regulation	.082	-1.743	5.10 (1.26)	5.32 (1.19)	
Study Skills	.087	-1.716	4.36 (1.21)	4.57 (1.21)	
Peer Help	.530	.629	3.49 (1.22)	3.41 (1.11)	
Self-regulated Learning (Comp)	.085	-1.729	4.50 (.89)	4.65 (.79)	
Course Grades	.224	-1.22	2.73 (1.31)	2.95 (1.24)	

Note. N equals 228 (full-time) and 143 (part-time) except for Course Grades in which N equals 129 (full-time) and 79 (part-time). Degrees of freedom are 369 for all variables except Course Grades which are 206 degrees of freedom. Bold-faced type denotes significant relationship.
[a]Huck and Cormier, 1996.

Part-time students reported higher levels of math anxiety but perceived math as more useful than full-time students. Results of the independent samples t-tests are presented in Table 21.

Math preparation.

Regardless of the level of math preparation, participants reported similar levels of self-regulatory strategies and math attitudes as the overall study sample. Effort regulation and environmental management were the most highly used strategies for students who required additional remediation and those who did not. As displayed in Table 22, perceptions of the usefulness of math were similar for both groups. Both groups perceived math as somewhat useful; however, they had neutral responses toward math anxiety. Interestingly, there were no

Table 22
Independent Samples T-tests: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Math Preparation

			Mean (SD)	
Dependent Variable	Sig.	t	Lower Developmental Math Required	Lower Developmental Math Not Required
Perceived Usefulness of Math	.386	-.869	3.59 (.88)	3.68 (.88)
Math Anxiety	.051	-1.957	2.77 (.88)	2.97 (.88)
Metacognitive Self-regulation	.666	-.433	4.62 (1.02)	4.68 (.99)
Environmental Management	.230	-1.204	5.07 (1.02)	5.21 (1.05)
Effort Regulation	.146	-1.456	5.11 (1.26)	5.33 (1.23)
Study Skills	.124	-1.543	4.37 (1.21)	4.58 (1.10)
Peer Help	.414	-.818	3.53 (1.18)	3.42 (1.13)
Self-regulated Learning (Comp)	.306	-1.025	4.53 (.86)	4.64 (.84)
Course Grade	.815	.235	2.82 (1.26)	2.78 (1.34)

Note. N equals 165 (lower developmental math) and 129 (non lower level developmental math) for Course Grades for which N equals 97 (lower developmental math) and 67 (non lower level developmental math). Degrees of freedom equal 292 for all variables except Course Grades for which degrees of freedom equal 162.

differences in math attitudes, self-regulatory strategy usage, or final course grades based on the amount of math remediation required. Hence, students who required more remediation were equally as likely to have positive feelings toward math, engage in self-regulatory strategies, and succeed in developmental math courses as those who did not require additional remediation.

Academic preparation.

Regardless of the number of academic deficiencies (by subject), participants were most likely to engage in effort regulation and environmental management, followed by metacognitive self-regulation, study strategies, and peer help. Students who were deficient only in math had the lowest mean score ($\bar{X}$=3.60) for perceived usefulness of math while students with two deficiencies (math and reading or writing) had the highest mean ($\bar{X}$=3.72); however, differences were not significant. Despite the number of academic deficiencies, students perceived math as somewhat useful. With regard to math anxiety, the mean for each group was close to 3.0, indicating that participants experienced average levels of math anxiety regardless of the extent of their academic deficiencies. As with math preparation, results from one way analyses of variance (ANOVA) showed that academic preparation did not influence attitudes toward math or self-regulatory strategy usage. Although it was expected that academic preparation would influence final course grades, the results indicated otherwise. Results of the analyses can be found in Table 23.

Summary of results for research question I: Differences in attitudinal and self-regulated learning based on demographic and academic factors.

The results of the various analyses demonstrate that there are differences in self-regulated learning, math attitudes, and developmental math course grades based on several background variables. With the exception of help seeking skills, differences existed on each of the self-

Table 23
ANOVA: Differences in Math Attitudes, Self-regulated Learning and Course Grades Based on Academic Preparation

Dependent Variable	Academic Deficiencies	Mean (SD)	F	Sig.	N
Usefulness of Math	Math Only	3.60 (.89)	.311	.818	215
	2 Deficiencies	3.72 (.84)			45
	3 Deficiencies	3.63 (.76)			45
Math Anxiety	Math Only	2.84 (.82)	1.718	.163	215
	2 Deficiencies	3.15 (.97)			45
	3 Deficiencies	2.85 (.90)			45
Metacognitive Self-regulation	Math Only	4.62 (.95)	.114	.952	215
	2 Deficiencies	4.67 (1.08)			45
	3 Deficiencies	4.61 (.92)			45
Environmental Management	Math Only	5.12 (1.04)	.163	.921	215
	2 Deficiencies	5.07 (1.02)			45
	3 Deficiencies	5.17 (.98)			45
Effort Regulation	Math Only	5.21 (1.21)	.108	.956	215
	2 Deficiencies	5.13 (1.48)			45
	3 Deficiencies	5.17 (1.51)			45
Study Skills	Math Only	4.42 (1.11)	.334	.801	215
	2 Deficiencies	4.53 (1.43)			45
	3 Deficiencies	4.58 (1.05)			45
Peer Help	Math Only	3.41 (1.11)	.526	.665	215
	2 Deficiencies	3.59 (1.25)			45
	3 Deficiencies	3.60 (1.32)			45
Self-regulated Learning (Composite)	Math Only	4.55 (.81)	.146	.932	215
	2 Deficiencies	4.60 (.94)			45
	3 Deficiencies	4.62 (.83)			45
Course Grade	Math Only	2.73 (1.28)	1.253	.288	123
	2 Deficiencies	3.14 (1.22)			29
	3 Deficiencies	2.71 (1.27)			21

Note. Degrees of freedom equal 3, 372 except for Course Grades for which degrees of freedom equal 2, 170.

regulated learning scales based on age, marital status, and dependents. For metacognitive self-regulation, effort regulation, environmental management, and overall self-regulatory strategy usage, students who were older, those who were married or divorced/separated, and those who had dependents were more likely to engage in the various strategies. With regard to study skills, students who were married were more likely than those who were divorced/separated or single to engage in study skills. Gender differences also existed based on several of the self-regulated learning scales. Female students were more likely than males to engage in effort regulation, environmental management, and self-regulated learning overall. Surprisingly, academic variables (enrollment status, math preparation, and academic preparation) had no bearing on self-regulated learning.

With regard to math attitudes, differences existed based on parent education level, dependents, and enrollment status. First generation students perceived math as more useful and experienced less anxiety toward math than continuing generation students. Students who had children were more likely to perceive math as being useful than students who did not have children. While full-time students had lower levels of math anxiety than part-time students, part-time students perceived math as being more useful. Interestingly, attitudes toward math did not differ by level of math or academic preparation.

Overall, participants performed well in their developmental math courses, with 80% earning a C or higher. However, females and non-traditional aged students outperformed males and traditional aged students. It is noteworthy that differences did not exist in developmental math course grades based on any of the academic variables. A summary of the significant findings are presented in Table 24.

Table 24
Summary of Significant Differences in Self-regulated Learning and Math Attitudes Based on Demographic and Academic Factors

<table>
<tr><th>Dependent Variable</th><th>Dependent Variable - Subscale</th><th>Significant Independent Variables</th></tr>
<tr><td rowspan="3">Self-regulated Learning</td><td>Metacognitive Self-regulation</td><td>The following participants were more likely than their counterparts to engage in metacognitive self-regulation:
• Students with dependents
• Married and divorced/separated students
• Non-traditional aged students</td></tr>
<tr><td>Environmental Management</td><td>The following participants were more likely than their counterparts to engage in environmental management:
• Females
• Students with dependents
• Married and divorced/separated students
• Non-traditional aged students</td></tr>
<tr><td>Effort Regulation</td><td>The following participants were more likely than their counterparts to engage in effort regulation:
• Females
• Students with dependents
• Married and divorced/separated students
• Non-traditional aged students</td></tr>
</table>

Dependent Variable	Dependent Variable - Subscale	Significant Independent Variables
	Study Skills	The following participants were more likely than their counterparts to engage in study skills: • Students with dependents • Married students • Non-traditional aged students
	Peer Help	No significant differences
	Self-regulated Learning Composite (Average)	The following participants were more likely than their counterparts to engage in self-regulated learning: • Females • Students with dependents • Married and divorced/separated students • Non-traditional aged students
Math Attitudes	Math Anxiety	The following participants experienced lower levels of math anxiety than their counterparts: • First generation students • Full-time students
	Perceived Usefulness of Math	The following participants perceived math as more useful than their counterparts: • First generation students • Students with children • Part-time students
Math Course Outcomes	Course Grade	The following participants earned higher grades than their counterparts: • Females • Non-traditional aged students

Research question II: Influence of math attitudes on self-regulated learning

Research question II investigated whether attitudes toward math related to self-regulated learning, after controlling for demographic and academic variables. Results from the multiple regression analysis revealed some significant relationships. Collectively, the demographic, academic and attitudinal variables explained a rather large portion, 24.6%, of the variance in self-regulated learning. Attitudes toward math (perceived usefulness of math and math anxiety) accounted for a substantial percentage, 12%, of the variance. Age, parent education, and perceived usefulness of math were uniquely predictive of self-regulatory strategy usage. Both age and perceived usefulness of math were positively correlated with self-directed learning whereas parent education was negatively correlated with self-regulated learning. The negative relationship with parent education indicates that continuing generation students (those for whom at least one parent holds a bachelor's degree or higher) had higher levels of self-regulated learning than their counterparts. The positive associations of age and perceived usefulness of math with self-regulated learning indicate that students who are older and those who perceive math as useful are more likely than younger students and those who do not perceive math as relevant to exhibit self-regulated learning strategies. It is noteworthy that math anxiety, math preparation, and academic preparation were not uniquely predictive of self-regulated learning. The Model Summary and ANOVA results are presented in Tables 25 and 26, respectively while predictors are displayed in Table 27.

Correlation analyses were conducted to analyze the relationship of self-regulated learning (composite) with background variables and math attitudes (math anxiety and perceived usefulness of math). Results indicated that math anxiety and perceived usefulness of math were significantly and positively correlated with self-regulated learning. Age, dependents, and gender were also significantly and positively associated with self-regulated learning. Thus, individuals who were older, had children, or were female were more likely to be self-directed learners. Marital status was significantly but negatively correlated with self-regulated learning indicating married individuals were more likely than unmarried participants to regulate their learning. Self-regulated learning, somewhat surprisingly, was not related to levels of academic preparation (degree of academic deficiencies). Results of the correlation matrix are presented in Appendix I.

Table 25
Model Summary for Multiple Regression Analysis: Influence of Math Attitudes on Self-regulated Learning

		Change Statistics				
Model	R Square	R Square Change	F Change	df1	df2	Sig. F Change
1	.118	.118	2.577	10	192	.006
2	.126	.008	.420	4	188	.794
3	**.246**	**.120**	**14.808**	**2**	**186**	**.001**

Note. Bold-faced type denotes significant relationship.
a) Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated)
b) Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated), Enrollment Status, Math Preparation, Academic Preparation (Two Deficiencies, Three Deficiencies)
c) Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated), Enrollment Status, Math Preparation, Academic Preparation (Two Deficiencies, Three Deficiencies), Perceived Usefulness of Math, Math Anxiety

Table 26
Influence of Math Attitudes on Self-regulated Learning

Model		df	F	Sig.
3	Regression	16	3.797	.001
	Residual	186		
	Total	202		

Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated), Enrollment Status, Math Preparation, Academic Preparation (Two Deficiencies, Three Deficiencies), Perceived Usefulness of Math, Math Anxiety
Dependent Variable: SRLAverage

Table 27
Multiple Regression Analysis: Demographic, Academic, and Attitudinal Predictors of Self-Regulated Learning (Model 3)

Model	Predictor	Standardized Coefficients ß	t	Sig.[a]
3	(Constant)		5.572	.000
	Gender	.131	1.934	.055
	Black	.003	.042	.967
	Latino	-.081	-1.210	.228
	Other Ethnicity	-.062	-.914	.362
	Hours Worked	-.074	-1.107	.270
	Age	**.242**	**3.064**	**.003**
	Parent Education	**-.188**	**-2.734**	**.007**
	Dependents	-.045	-.533	.595
	Married	-.160	-1.894	.060
	Divorced/Separated	.033	.454	.650
	Enrollment Status	.016	.228	.820
	Math Preparation	.043	.579	.564
	Academic Preparation (Two Deficiencies)	-.034	-.478	.633
	Academic Preparation (Three Deficiencies)	-.056	-.766	.445
	Math Anxiety	.126	1.767	.079
	Perceived Usefulness of Math	**.306**	**4.313**	**.001**

Note. Dependent variable is SRLAverage.
[a]Bold type denotes significant relationship.

In summary, the multiple regression analysis demonstrated that, collectively, attitudes toward math were significantly predictive of self-regulated learning. Age, parent education, and perceived usefulness of math were unique predictors of self-regulated learning. Perceived usefulness of math was positively related to self-regulated learning and was the strongest of the three predictors. Math anxiety, the other measure of math attitudes, was not significantly related to self-regulated learning. Overall, students who had better attitudes toward math were more likely to employ behaviors of self-regulated learners. This supported the hypothesis that attitudes toward math influence self-regulated learning.

Research question III: Influence of self-regulatory strategies on developmental math course grades

The third research question examined the influence of self-regulatory learning skills and attitudes toward math on math course success (grades) among developmental math students. The regression analysis revealed important findings. Collectively, the independent variables accounted for a considerable 32.2% of the variance in final course grades. After controlling for demographic, academic, and attitudinal factors, self-regulatory strategy usage significantly added to the explanation of variance, accounting for an additional 7.4% of the variance in final course grades. Hence, participants with higher levels of self-regulatory strategy usage were more likely than their peers to earn good grades. The results confirmed the hypothesis that self-regulated learning influences final course grades. Tables 28 and 29 display the Model Summary and ANOVA results, respectively. Table 30 presents the contributions of each of the predictor variables in the analysis.

After controlling for demographic and academic characteristics and math attitudes, self-regulated learning was related to final course grades in developmental math. Thus, students who engaged in self-regulatory learning strategies performed better in developmental math than their peers.

Several statistically significant correlations were found between final course grades and the independent variables. Variables that were significantly related to final grades were gender (female), age, academic preparation (two deficiencies), math attitudes (math anxiety and perceived usefulness of math), and self-regulatory strategy usage. All correlations were positive except academic preparation. Students with academic deficiencies in two areas (math and reading or writing) were less likely to earn good grades than their peers. The strongest correlation (r = .417) was between self-regulated learning and final grades. The correlation matrix is presented in Appendix J.

Table 28
Multiple Regression Analysis: Model Summary for Final Course Grade

		Change Statistics				
Model	R Square	R Square Change	F Change	df1	df2	Sig. F Change
1	.132	.132	1.611	10	106	.113
2	.198	.066	2.099	4	102	.086
3	.248	.050	3.334	2	100	.040
4	**.322**	**.074**	**10.741**	**1**	**99**	**.001**

a Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated)
b Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated), Enrollment Status, Math Preparation, Academic Preparation (Two Deficiencies, Three Deficiencies)
c Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated), Enrollment Status, Math Preparation, Academic Preparation (Two Deficiencies, Three Deficiencies), Perceived Usefulness of Math, Math Anxiety
d Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated), Enrollment Status, Math Preparation, Academic Preparation (Two Deficiencies, Three Deficiencies), Perceived Usefulness of Math, Math Anxiety, SRLAverage

Table 29
ANOVA for Final Course Grades

Model		df	F	Sig.
4	Regression	17	2.761	.001(d)
	Residual	99		
	Total	116		

Predictors: (Constant), Gender, Ethnicity (Black, Latino, Other), Hours Worked, Age, Parent Education, Dependents, Marital Status (Married, Divorced/Separated), Enrollment Status, Math Preparation, Academic Preparation (Two Deficiencies, Three Deficiencies), Perceived Usefulness of Math, Math Anxiety, SRLAverage
Dependent Variable: FinalGrade

Table 30
Multiple Regression Analysis: Predictors of Final Course Grade

Model	Predictors	Standardized Coefficients ß	t	Sig.
4	(Constant)		-1.924	.057
	Gender	.143	1.600	.113
	Black	.106	1.147	.254
	Latino	.135	1.492	.139
	Other Ethnicity	.138	1.536	.128
	Hours Worked	.072	.837	.405
	Age	.170	1.659	.100
	Parent Education	.124	1.331	.186
	Dependents	-.039	-.356	.722
	Married	.034	.310	.757
	Divorced/Separated	.094	1.040	.301
	Enrollment Status	.068	.737	.463
	Math Preparation	-.152	-1.557	.123
	Academic Preparation (Two Deficiencies)	-.160	-1.694	.093
	Academic Preparation (Three Deficiencies)	.027	.281	.779
	Math Anxiety	.159	1.602	.112
	Perceived Usefulness of Math	-.017	-.165	.869
	SRLAverage	**.319**	**3.277**	**.001**

Note. Bold-faced type denotes significant relationship.

Research question IV: Influence of self-regulated learning and math attitudes on developmental math course persistence

The final research question was intended to examine the influence of self-regulated learning and attitudes toward math on developmental math course persistence; however, only eight participants withdrew from the math course. As a result, there was insufficient data to conduct the analysis.

Summary of research findings

This chapter presented results of the analyses. The first research topic investigated differences in self-regulated learning, math attitudes, and course outcomes based on demographic and academic variables. It is noteworthy that differences did not exist with regard to course grades based on any of the academic factors, despite the fact that differences based on math and academic preparation were expected. Only gender and age differences existed based on course grades, with females and non-traditional aged students performing better in developmental math than males and traditional aged students.

Enrollment status was the only academic variable to result in any significant differences, and that was only with regard to math attitudes. Part-time students perceived math as more useful but experienced more anxiety toward math than full-time students. Although it is not particularly surprising that differences existed by enrollment status, the direction of the relationship regarding perceived usefulness of math was unexpected. In addition to enrollment status, parent education and dependents also resulted in significant findings as pertain to math attitudes. First generation students perceived math as more useful and experienced less math anxiety than continuing generation students. The direction of those relationships was also unanticipated. Finally, students with dependents were more likely than those who did not have children to perceive math as useful, but the two groups did not differ based on math anxiety.

With regard to self-regulated learning, differences in age, gender, marital status, and dependents existed. Students who were older, married or divorced/separated, and students with dependents were more likely to engage in the self-regulatory strategies of metacognitive self-regulation, environmental management, effort regulation, study skills (divorced/separated students were not more likely to engage in study skills), and overall self-regulatory strategy usage than their counterparts. In addition, female students were more likely than males to manage their environment, regulate their effort, and use self-regulatory strategies.

The second research question investigated the relationship between math attitudes and self-regulated learning after controlling for demographic and academic variables. Results showed that, collectively, attitudes toward math were highly predictive of self-regulated learning strategies, accounting for a large percentage (12%) of variance. Perceived usefulness of math was uniquely predictive of self-regulated learning; however, math anxiety was not. Age and parent education level were also uniquely predictive of self-regulated learning with non-traditional aged students and continuing generation students being more likely to regulate their learning.

The final analysis was conducted to determine if self-regulated learning was predictive of course grades in developmental math. Results revealed that self-regulated learning influenced final grades in developmental math, accounting for 7.4% of the variance. Only self-regulatory strategy usage proved to be uniquely predictive of success in developmental math. Neither of the two math attitudes was uniquely predictive of final course grades. A discussion of the major findings in presented in the following chapter.

Discussion

Many students, particularly at the community college level, enter college underprepared academically (ACT, 2008; McCabe, 2000; Venezia, Kirst, & Antonio, 2004). This is especially the case in math (Boylan & Saxon, 1999; Provasnik & Planty, 2008). Developmental math courses are designed to help students improve their math skills and prepare for college level math courses. There is considerable speculation that affective and other non-cognitive factors are important to academic achievement (Gerlaugh et al., 2007; Saxon et al., 2008; Sedlacek, 2004), but little empirical research exists as to the influence of non-cognitive factors on the academic achievement (course outcomes) of developmental math students. Therefore, this study focused on identifying non-cognitive factors (math attitudes and self-regulated learning) that predict success in developmental math courses.

Self-regulated learning provides the theoretical foundation for this study. Self-regulated learning involves behavioral, motivational, and metacognitive components of learning (Zimmerman, 1990). This study provides insight into the learning strategies of developmental math students and the attitudinal factors (attitudes toward math) that influence achievement in developmental math. Math attitudes and self-regulated learning skills are the focus of the study because together they represent motivational, metacognitive, and behavioral aspects of the learning process.

It was hypothesized that students who have more positive attitudes toward math and who engage in self-regulated learning strategies would be more successful in developmental math courses than their peers. As such, this study examined the relationship among learning strategies, math attitudes, and academic success in developmental math. The first research question analyzed differences in math attitudes, self-regulated learning, and math course outcomes based on demographic and academic characteristics. The second research question investigated the relationship between math attitudes and self-regulated learning while the third research question examined the influence of math attitudes and self-regulated learning strategies on math course outcomes. The major findings are discussed in the following section.

Findings

Research question I: Differences in math attitudes, self-regulated learning, and course outcomes based on background variables.

The first research question investigated differences in self-regulated learning, math attitudes, and developmental math course outcomes based on demographic and academic characteristics. Differences that existed in self-regulated learning, math attitudes, and course grades based on demographic and academic characteristics are described below.

Self-regulated learning.

Self-regulated learning indicated the degree to which participants actively engaged in the learning process. Specifically, it measured participants' ability to control cognitive, metacognitive, and behavioral aspects of learning. Self-regulated learning was comprised of five subscales including metacognitive self-regulation, environmental management, effort regulation, study skills, and peer help. Students were most likely to engage in effort regulation and environmental structuring. The scores indicate that students were able to regulate their effort and manage their environment relatively well. Participants were somewhat less likely to engage in metacognitive self-regulation and study skills. Overall, the results indicate that developmental math students would benefit from using metacognitive self-regulation and study strategies more consistently. Students were least likely to engage in help-seeking strategies, indicating they were not likely to request help from others. Although results indicate that participants used self-regulatory strategies, there was considerable room for improvement. Therefore, it may be helpful for developmental learners to receive instruction on the use of self-regulatory strategies.

With regard to self-regulated learning, differences were present based on the following demographic and academic characteristics: gender, dependents, marital status, and age. Results differed somewhat based on the specific type of self-regulatory strategy under investigation.

Gender.

Gender differences existed with regard to environmental management, effort regulation, and self-regulatory strategy usage (overall) with females reporting significantly higher strategy usage than males in each of those areas. Females were likely to engage in self-regulated learning strategies, particularly with regard to maintaining effort and structuring their environment. Females were slightly more likely than males to regulate their effort and direct their learning, in general, but were noticeably more likely to structure the learning environment.

Gender differences in self-regulatory strategy usage were noted by Ablard and Lipschultz (1998) who concluded that, among high achieving seventh graders, females were more likely than males to complete homework when they did not understand a problem (Ablard & Lipschultz, 1998). Although the samples differed considerably, the findings are consistent in that females were more likely to regulate their effort when faced with challenging problems or other distractions. The finding that females are more likely than males to regulate their learning may help explain research findings that females outperformed males in math (Ikegulu, 2000; Updegraff & Eccles, 1996) despite having less positive feelings toward the subject (Bohuslov, 1980; Hembree, 1990; Ma & Cartwright, 2003; Updegraff & Eccles, 1996).

Dependents.

Students with dependents were among the most likely to engage in self-regulated learning and to perceive math as useful. Students with dependents reported high levels of effort regulation and environmental management. Results revealed that students who had children were more likely than their counterparts to engage in metacognitive self-regulation, environmental management, effort regulation, study skills, and overall self-regulatory strategy usage. Students with dependents were slightly more likely than their peers to use most learning strategies but quite a bit more likely to regulate their effort. It appears that students with dependents have learned to manage their behavior and environment better than individuals who do not have children.

This is an interesting finding because it would seem that students with children would face more distractions while trying to study and complete homework. The results, however, indicate that students with dependents are successful at overcoming distractions and remaining focused on the task at hand. It is possible that the study participants may have had help with child care or that their children were independent enough to not distract their parent during study time. This finding could also represent a high level of determination on the part of students who are parents to earn a degree. The literature does not include discussions of self-regulated learning and parenthood, so this is an area that could be explored in future studies.

Age.

Age was significantly correlated with all self-regulated learning scales except help seeking/peer support. Age was most highly correlated with environmental management, followed by effort regulation, metacognitive self-regulation, and study skills. The relationship between age and environmental management was moderately high, indicating that older students were quite a bit more likely than their younger counterparts to structure their learning environment. Non-traditional aged students were somewhat more likely than traditional aged students to regulate their learning and to use metacognitive skills and study strategies. The positive correlation between age and self-regulatory strategy usage indicates that older students showed higher levels of engagement in self-regulatory strategies than did their younger peers.

Marital Status.

Students who are married or divorced/separated were among the most likely to engage in self-regulated learning strategies. Divorced/separated and married students reported high levels of effort regulation, environmental management, and metacognitive self-regulation. Although single students were somewhat likely to use effort regulation and environmental structuring, they were significantly less likely to engage in metacognitive self-regulatory strategies, environmental management techniques, and effort regulation than married or divorced/separated students. Married students exhibited higher usage of study skills than single students. It may be that married and divorced/separated students, as well as students with dependents, are older than single students and the differences are more a product of age or maturity than marital status. Indeed, Pearson correlations confirm that age is significantly and highly related to marital status and having dependents ($p < .01$).

Summary of differences in self-regulated learning.

The analyses failed to show statistical differences in self-regulated learning based on other demographic or academic factors. Interestingly, factors that are typically expected to relate to academic attainment such as parent education, enrollment status, and math preparation were not distinguishing characteristics in terms of self-regulatory strategy usage. That is promising as it implies that students who are underprepared or who lack some of the advantages of other students (i.e., parent education), are just as likely as their peers to engage in self-regulatory strategy usage. It appears that maturational factors such as age, parenthood, and marital status are more important than academic factors with regard to self-regulatory strategy usage.

Attitudes toward math.

In terms of attitudes toward math, perceptions of the usefulness of math and feelings of anxiety toward math were examined. Overall, participants perceived math as fairly relevant to their lives. Students generally agreed that math is relevant to their lives, but they did not hold strongly to those beliefs. With regard to math anxiety, the findings were positive. Responses to math anxiety were neutral, indicating that students were somewhat indifferent to math anxiety. While some students may experience math anxiety, it does not appear to be a debilitating factor that hinders the academic success of most developmental learners. Findings from independent samples t-tests suggest that there are differences in attitudes toward math based on parent education, enrollment status, and parenthood.

Parent education.

First generation students perceived math as relatively useful. Continuing generation students, on the other hand, perceived math as somewhat, albeit less relevant, than their peers. With regard to math anxiety, continuing generation students experienced slightly more anxiety than first generation students. Surprisingly, first generation students had more positive attitudes toward math than their peers whose parent(s) had earned a bachelor's degree. This was an unexpected finding since first generation students tend to have lower levels of academic performance and a higher likelihood of needing remediation in math (Chen, 2005).

Enrollment status.

With regard to enrollment status, full-time students perceived math as somewhat relevant but slightly less so than did part-time students. Although part-time students perceived math as more relevant than full-time students, part-time students were more likely to feel anxious toward math than their counterparts. Differences between the groups in their attitudes toward math were modest. The results were somewhat unexpected as full-time students who spend more time on campus would seem more likely to have positive attitudes toward math than students who attend college on a part-time basis.

Dependents.

Students with dependents were likely to perceive math as useful, but their counterparts were among the least likely of all students to perceive math as relevant. Significant differences existed among students who had dependents and those who did not in the perceptions of the relevance of math. Previous literature has not addressed the role of parenthood with regard to math attitudes. Therefore, this is an area that may be explored in more detail in future studies.

Summary of differences in attitudes toward math.

Differences in math attitudes were not found with regard to other variables. This is interesting given the previous literature on the relationship between math attitudes and characteristics such as gender, ethnicity, and age, in particular. Although results regarding gender differences in attitudes toward math have been mixed, several studies have shown that differences in math attitudes exist based on gender, with males being more likely to perceive math as useful and less likely to experience math anxiety (Bohuslov, 1980; Fennema & Sherman, 1977; Ma & Cartwright, 2003; Updegraff & Eccles, 1996). With regard to math anxiety, Bessant (1995) and Hembree (1990) concluded that females were more prone to anxiety than males.

However, other studies resulted in findings that were consistent with the present study in that they showed no gender differences with regard to math anxiety (Alexander & Cobb, 1984; Cooper & Robinson, 1991; Kazelskis et al., 2000; Ma, 1999). The inconsistency in results may be a result of accounting for other factors such as math ability or math affect, as Fennema and Sherman (1977) suggested, that may be more relevant than gender. Their research showed that gender was not a significant factor when accounting for other variables (Fennema & Sherman, 1977).

The findings of this study showed no differences in math attitudes as a result of ethnicity, yet ethnic differences have been noted in some studies (Hembree, 1990; Ma and Cartwright, 2003). The results are not necessarily contrary, however, since the purpose and methodology of each study differed substantially.

Findings from the literature on the relationship between math attitudes and age have been varied. There was not a significant correlation between math attitudes and age in this study which is consistent with Bitner (1994) and Hembree (1990). However, other studies have found age differences in math anxiety with non-traditional aged students experiencing higher levels of math anxiety than traditional aged students (Bessant, 1995; Betz, 1978).

It was surprising to find that attitudes toward math did not differ based on math or academic preparation. Students who were underprepared only in math did not differ from students who were deficient in multiple subjects (math along with reading and/or writing) with regard to either perceived usefulness of math or math anxiety. Grimes & David (1999) found that underprepared and college ready students differed based on non-cognitive factors. Although they did not address math attitudes, the results of their study indicate that there may be a relationship between academic preparation and non-cognitive factors. This is an area in which future research is recommended.

Math course outcomes.

Participants performed better than expected in their developmental math courses. Overall, eighty percent earned a passing grade (C or higher). Withdrawal rates were virtually non-existent while D and F grades were nominal. An eighty percent success rate is remarkable considering the literature on success rates in developmental math and the recent pass rates of developmental math students at the College (Adelman, 2004; Performance Agreement, 2009; Gerlaugh, Thompson, Boylan, & Davis, 2007). The results of this study indicate that final grades in developmental math differed based on gender and age. Interestingly, course grades did not differ based on any of the other demographic or academic characteristics in the study.

Gender.

Females performed quite well in developmental math, earning a B average. The performance of males was considerably lower at just above a C average. Females had significantly higher final grades in developmental math than did males, which was consistent with the literature (Ikegulu, 2000; Updegraff & Eccles, 1996).

Age.

Results from a Pearson correlation show that as age increases, final course grades also rise. There is a moderately strong, positive relationship ($r = .309$) between age and final course grades. Non-traditional aged students earned considerably higher math grades than traditional aged students.

Summary of differences in math course outcomes.

Factors such as math preparation, academic preparation, and parent education level that would seem to relate to academic achievement (Curtis, 2002; Grimes & David, 1999; McCabe, 2000; Weissman et al., 1995) were not indicative of math outcomes, which was contrary to expectations. It would seem that those variables would be more likely to reflect math outcomes than demographic characteristics such as gender and age; however, the results of this study indicate otherwise. The most surprising finding related to this research question is that there were no differences in developmental math course success, self-regulated learning, or attitudes toward math based on math or other academic deficiencies. It was expected that those variables would be significantly related to math course outcomes as well as self-regulated learning and math attitudes. Thus, it appears that academic preparation may be less important than other factors when it comes to academic success of developmental learners.

Research question II: Self-regulated learning and math attitudes.

The second research question investigated the relationship between math attitudes and self-regulated learning after controlling for demographic and academic characteristics. It was hypothesized that positive attitudes toward math would influence self-regulated learning by enhancing motivation and helping students sustain effort when completing math work. Results from the multiple regression analysis revealed that math attitudes, as a whole, were significantly related to self-regulated learning. Math attitudes contributed significantly to self-regulated learning. Perceptions of the usefulness of math proved to be uniquely predictive of self-regulated learning; however, math anxiety was not. Age and parent education were also uniquely predictive of self-regulatory strategy usage.

The results were consistent with Chouinard and his colleagues (2007) who reported that perceptions of the relevance of math were indirectly related to the amount of effort exerted (effort regulation). The findings support the hypothesis that math attitudes and self-regulated learning are related. The results also provide some support for Drew's (1996) belief that perseverance and hard work are more important to learning math than intelligence alone. The findings indicate that attitudes toward math play a role in the study behaviors of students. The results are similar to those of Bembenutty and Zimmerman (2003) who concluded that homework completion and math grades were a result of self-regulatory strategy usage. Although the motivational/attitudinal variables in the two studies differ, the significance of the variables may indicate that non-cognitive factors such as motivation and attitudes are influential with regard to self-regulatory strategy usage.

Many researchers believe that negative attitudes toward math affect learning (Bassarear, 1986; Chouinard et al., 2007; Fennema & Sherman, 1976; Gourgey, 1984; Ikegulu, 2000; Kincaid & Austin-Martin, 1981; Ma, 1997; McLeod, 1994; Middleton & Midgley, 1997; Stipek et al., 1998; Updegraff & Eccles, 1996). In this study, math anxiety was related to each type of self-regulated learning including metacognitive self-regulation, environmental management, effort regulation, study skills, and help seeking. However, math anxiety was not predictive of self-regulated learning after accounting for other variables. Only age and parent education significantly influenced self-regulated learning. The findings indicate that other factors are more important to self-regulated learning than math attitudes.

In conclusion, math attitudes explained a considerable portion of the variance in self-regulated learning. Of the two math attitudes included in this study, only perceived usefulness of math was uniquely predictive of self-regulatory strategy usage. Age and parent education were the only other characteristics that significantly predicted self-regulated learning. Of the three predictors, perceived usefulness of math was the strongest. The findings indicate that attitudes toward math were an important component of self-regulated learning among the developmental math students who participated in the study. Additional research on this topic is needed to determine if the results may be generalizable beyond the scope of this study. Future research may also want to investigate the role that attitudes toward other subjects plays in academic success. Another avenue for future research is the influence of other non-cognitive factors on the academic success of underprepared college students.

Research question III: Math attitudes, self-regulated learning, and developmental math course outcomes.

The third research question examined the influence of math attitudes and self-regulated learning on final math course grades. Specifically, the purpose of this research question was to identify the factors that relate to achievement (course grades) in developmental math. Results of the multiple regression analysis revealed that self-regulated learning was predictive of final course grades. Self-regulated learning explained a significant portion of the variance in final grades and was the only factor that uniquely predicted math course grades. Self-regulatory skills are commonly associated with academic achievement indicators (Bembenutty & Zimmerman, 2003; Brothen & Wambach, 2000; Cantwell, 1998; Garavalia & Ray, 2003; Nota, Soresi, & Zimmerman, 2004; Pintrich & DeGroot, 1990; Ruban et al., 2002; Trainin & Swanson, 2005; Zimmerman & Bandura, 1994). The findings of this study are similar to the results of other studies that demonstrate that self-regulatory learning strategies influence the academic success of college students (Brothen & Wambach, 2000; Garavalia & Ray, 2003; Ruban et al., 2002; Ruban & Nora, 2002). However, the results of this study contradict the findings of Young and Ley

(2005) who concluded that self-regulatory strategy usage was not related to academic achievement among developmental college students. There were some methodological issues that may have affected their results, however. The findings from this study showed that self-regulated learning is a significant predictor of final course grades in developmental math. The hypothesis was confirmed in that self-regulated learning was influential in predicting final math grades among developmental students.

Correlation analyses indicated that math attitudes and self-regulated learning were related to math course grades. Variables that were significantly related to final grades were gender, age, academic preparation (two deficiencies), math attitudes (math anxiety and perceived usefulness of math), and self-regulatory strategy usage. All variables except academic preparation were positively correlated with final grades. Students with academic deficiencies in two areas (math and reading or writing) were less likely to earn good grades than their peers. The strongest correlation was between self-regulated learning and final grades, indicating that there is a moderately strong relationship between self-regulated learning and academic achievement in developmental math.

The results of this study are similar to the results of other studies that show that math attitudes are correlated with academic performance. Several studies support the claim that perceptions of the usefulness of math are related to math achievement (Bassarear, 1986; Greene, DeBacker, Ravindran & Krows, 1999; Op't & De Corte, 2003; Singh et al., 2002). The results are consistent with Bassarear's (1986) finding that math attitudes collectively related to performance among developmental math students. Interestingly, he, too, concluded that perceived usefulness of math was not uniquely predictive of math course success (Bassarear, 1986).

Unfortunately, due to collinearity of the self-regulatory learning scales, it was not possible to determine which self-regulatory strategies were most predictive of final course grades. Future research can investigate the role of specific types of self-regulatory strategies and their influence on academic success. Overall, the results of this study imply that non-cognitive factors are an important aspect of the academic success of developmental math students.

Contributions to the literature

Results of the study provide some rather promising insight into the attitudes and behaviors of developmental math students at a community college. The findings indicate that developmental math students perceived math as somewhat useful. The results also showed that while developmental math students were not particularly comfortable with math, they were not especially anxious toward the subject either. Developmental students were somewhat likely to use self-regulatory strategies, the most common of which were effort regulation and environmental management. They also utilized metacognitive self-regulation and study strategies but to a lesser extent. It appears that developmental learners rarely sought help when experiencing difficulty in math. Fortunately, it seems that developmental students have a repertoire of self-regulatory strategies that they can use, although there is certainly room for improvement and increased usage.

The study examined differences in math attitudes, self-regulated learning, and final grades in developmental math based on demographic and academic characteristics. With regard to math attitudes, the results were surprising in that a) first generation students had more positive attitudes toward math (perceived math as more relevant and experienced less math anxiety) than continuing generation students and b) part-time students perceived math as more relevant than full-time students. With regard to self-regulated learning, the most noteworthy finding was that differences based on academic factors (math preparation, academic preparation, parent education, and enrollment status) did not exist. Although such factors are generally expected to relate to academic attainment, the relationship was not confirmed in this study. Findings showed that maturational factors such as age and marital status were the distinguishing factors with regard to self-regulatory strategy usage. With regard to developmental math course grades, differences existed based only on gender and age. There was a large difference in course grades between females and males, with females substantially outperforming males. Likewise, non-traditional aged students outperformed traditional aged students by a relatively large margin.

The study also investigated the relationship between math attitudes and self-regulated learning. It was believed that math attitudes would significantly influence the use of self-regulatory strategies, and the hypothesis was confirmed. Math attitudes collectively influenced self-regulated learning. Perceived usefulness of math uniquely predicted self-regulated learning; however, math anxiety was not a significant individual contributor. It appears that students who have positive attitudes toward math are more likely to engage in self-regulatory behaviors.

The primary purpose of this study was to identify non-cognitive predictors of developmental math course outcomes. Specifically, the study examined the influence of demographic and academic characteristics, attitudes toward math, and self-regulatory learning strategies on developmental math course grades among community college students. The independent variables accounted for nearly one-third of the variance in developmental math course grades, thereby exerting a strong influence on academic success. Self-regulated learning was predictive of developmental math grades. Thus, students with higher levels of self-regulatory strategy usage were more likely than their peers to earn higher grades in developmental math courses. This is an important contribution to the literature as it demonstrates that non-cognitive factors (in this case, self-regulated learning) play a role in the academic success of developmental students. Although there are certainly factors outside the scope of this study that influence academic outcomes in developmental math, the findings from this study have practical application.

Implications

This study adds to the literature concerning the attitudes and self-regulatory strategies of developmental learners, and the results have implications for educational policy and practice. The significance of the findings concerning the influence of self-regulatory strategy usage on math course success suggests that non-cognitive factors are one element related to academic achievement. Colleges and universities should consider adopting assessment and placement policies that account for factors other than ability. Postsecondary institutions should consider using not only cognitive measures of student ability but also non-cognitive measures, such as self-regulatory strategy usage. Based on a previous study, only seven percent of community college developmental education programs assessed non-cognitive factors (Gerlaugh, et al., 2007). By supplementing cognitive measures with non-cognitive assessments, institutions may be better able to predict readiness for college coursework and diagnose students' needs and abilities (Saxon, Levine-Brown, & Boylan, 2008; Sedlacek, 2004). Furthermore, institutions can devise strategies that would enable students who are self-regulated learners to move more quickly through developmental education programs.

The relationship between self-regulated learning and success in developmental math suggests that developmental education programs should include instructional components to help students develop effective self-regulatory strategies. By teaching self-regulatory strategies and the application of those strategies to math, developmental education practitioners may enhance student success. Study participants did not use self-regulatory strategies to a great extent. Therefore, the development of self-regulatory skills would enable students to become independent, lifelong learners who are capable of applying those skills to other courses. Establishing a separate course that emphasizes the development of self-regulatory skills, integrating the material directly into the curriculum of specific developmental courses, or creating a learning community in which a content course, such as math, is supported by a learning strategies course are a few ways that developmental education programs can incorporate self-regulatory skill development.

Because failure and withdrawal rates in developmental math are the highest among all courses nationwide (Adelman, 2004), it would be wise for educational administrators to implement techniques to improve success rates in math, move students through the developmental sequence more quickly, increase retention, and reduce instructional costs. For example, institutions could use the results of this study to develop and implement intervention programs targeted specifically for developmental math students who are less likely to succeed. They could also incorporate the use of self-regulatory learning assessments to enhance academic advising and counseling for at risk students (Sedlacek, 2004). Advisors and counselors could help students recognize how their attitudes and behaviors contribute to course outcomes. In summary, the findings could help institutions establish policies and practices that better meet the needs of developmental learners and the institution, by improving developmental students' likelihood of success. Since there are a variety of factors outside the scope of this study that influence academic achievement, the results of this study provide a starting point for considering methods of enhancing student success in developmental math.

Limitations

There are several limitations related to this study including generalizability of the results, instrumentation, and relationships among variables. Because the study was conducted at a large, public community college in the Midwest, the student body, institutional culture, and attitudes toward developmental education may differ substantially from other institutions. Although developmental education is a well understood term in higher education, developmental education policies and practices differ greatly across institutions and states. Postsecondary institutions differ in terms of assessment and placement requirements (mandatory or voluntary), developmental course offerings (single or multiple levels), and course outcomes. The vast differences in policies and practices limit the generalizability of the findings.

There are also some limitations related to the survey instrument. First, the survey instrument is an indirect measure of math attitudes and self-regulated learning. Since it involves self-reported measures of math attitudes and self-regulated learning and the data was not triangulated, it was not possible to confirm that students provided an accurate representation of their attitudes or their learning strategy usage. Other data collection methods (i.e., logs, observations) may provide more accurate data (Ruban et al., 2002; Tittle & Hecht, 1992). A few researchers reported concerns about developmental students exaggerating their use of self-regulatory strategies (Garavalia & Ray, 2003; Young & Ley, 2005). It is possible that students over-emphasized their use of the strategies; however, the findings of this study imply that developmental math students who performed well used self-regulatory strategies to an adequate extent since self-regulated learning was related to final grades. Furthermore, students may have interpreted the Likert scales differently. For example, what one participant considered “very true of me” may not have been congruent with other students’ interpretations. Use of a Likert scale is also limiting in that it may be difficult for participants to express attitudinal nuances in forced-choice questionnaires (Bessant, 1995).

The timing for administering the survey is also a potential limitation. The survey was conducted during the second half of the summer and fall terms to give students an ample amount of time to apply self-regulatory behaviors to their developmental math courses. However, the timing may have been far enough into the course that most students who withdrew would have already done so. Data could not be collected from students who withdrew prior to administration of the survey, and it is possible that students who withdrew earlier in the semester may have differed with regard to self-regulatory strategy usage or other characteristics compared with students who persisted. It is also quite possible that there are few students who withdraw in the latter half of the term which would imply that the number of students who withdraw is higher than the data from this study indicate.

A few potential data related problems exist. An important limitation to note concerns intercorrelations among certain variables. Specifically, the self-regulated learning variables were correlated highly with one another. As a result, only the composite scale was used in the analysis of the relationship between course outcomes and self-regulated learning, so it was not possible to elaborate on the types of self-regulatory strategies that may be most related to success in developmental math courses. This problem may have resulted from modification of the MSLQ survey instrument. Another data-related limitation involves the inability to collect final grades for a large number of participants. This resulted in a relatively small sample size that increased the likelihood of a Type I error. Another byproduct of not having all of the final grades was that there was an insufficient number of students who had withdrawn from the course to conduct an analysis of the final research question regarding predictors of math course persistence. Thus, the only math outcome that could be assessed was final grades.

Future Research

This study focused on the influence of math attitudes and self-regulatory learning strategies on success in developmental math courses. In the future, the study could be expanded to include students who are academically underprepared in other subjects. Another avenue would be to consider other affective, motivational, or behavioral factors that may relate to academic success. Future research could also attempt to identify specific self-regulatory strategies that contribute to success in developmental math or other courses.

As more adults are attending college, it would be interesting to learn more about the self-regulatory strategy usage of adult learners. Age was a distinguishing factor in use of self-regulated learning strategies so future research could assess the differences between adult learners and traditional aged students with regard to metacognitive, behavioral, and motivational aspects of learning. With the growing popularity of online courses, it would also be interesting to learn more about how self-regulated learning influences academic success in online courses.

Conclusion

This study focused on factors that contribute to the academic success of students who were underprepared for college level math. The study was grounded in the theory of academic self-regulation, or the ability of the learner to control motivational, behavioral, and metacognitive aspects of the learning environment. The study provides support for the relationship between self-regulatory strategy usage and academic success among developmental college students.

Math attitudes significantly influenced self-regulated learning. Likewise, self-regulated learning significantly influenced course outcomes among developmental math students. With regard to academic success, gender, age, academic deficiencies (math and reading or writing), math anxiety, perceived usefulness of math, and self-regulated learning were predictive of final course grades in math. Females, non-traditional aged students, students who required remediation only in math (as opposed to two subjects), students who had positive attitudes toward math, and those who engaged in self-regulated learning strategies were more likely to perform well academically in developmental math than their counterparts. These findings were congruent with expectations, as academic preparation, math attitudes, and self-regulated learning were expected to influence math course outcomes. As anticipated, self-regulated learning was significantly related to final course grades. Hence, students who were capable of effectively regulating the learning environment were more likely to earn higher grades in developmental math than students who did not engage in self-regulatory strategies.

It appears that developmental students who have more positive attitudes toward math are more likely to engage in study strategies that lead to academic success. It stands to reason that students who control their learning environment by engaging in behaviors such as goal setting, monitoring, regulating effort, organizing, and structuring the learning environment would be more likely to perform well academically than students who do not engage in those types of study strategies.

Overall, this study demonstrates the importance of non-cognitive factors in the academic success of underprepared students. After controlling for background variables and math attitudes, self-regulated learning was significantly predictive of final course grades in developmental math. Colleges and universities typically focus on cognitive factors when assessing student ability; however, this study demonstrates that non-cognitive factors such as motivation, learning strategies, and attitudes are also influential to academic success of developmental math students. Therefore, colleges and universities should consider non-cognitive factors such as motivation, self-regulation, and attitudes that may influence academic success more so than cognitive factors alone.

In conclusion, this study adds to the literature on factors that influence success among developmental math students. The outcomes demonstrate that math attitudes and self-regulated learning are important components of academic success in developmental math. The study also reveals the important role that non-cognitive factors play in the academic success of underprepared students. By equipping students with self-regulatory skills and providing support systems that enhance students' attitudes toward learning, the greater the likelihood of academic success among students who are underprepared. Hopefully, future research will continue to explore the relationship between non-cognitive factors and academic success to shed additional light on how to better educate the myriad of students who are entering college academically underprepared.

References

Ablard, K. E. & Lipschultz, R. E. (1998). Self-regulated learning in high-achieving students: Relations to advanced reasoning, achievement goals, and gender. *Journal of Educational Psychology, 90 (1),* 94-101.

ACT Faces of the Future Survey (2001-2005). Retrieved March 15, 2009, from http://ir.butlercc.edu/parts/Performance%20Mgt/Faces%20Graphs.pdf

Adelman, C. (1999). Answers in the Tool Box: Academic Intensity, Attendance Patterns, and Bachelor's Degree Attainment. Washington, DC: *National Institute on Postsecondary Education, Libraries, and Lifelong Learning*. (ERIC Document Reproduction Service No. ED 431363).

Adelman, C. (2004). *Principle indicators of student academic histories in postsecondary education, 1972-2000.* Washington, DC: U.S. Department of Education, Institute of Education Sciences.

Alexander, L. & Cobb, R. (1984, November). *Identification of the dimensions and predictors of math anxiety among college students.* Paper presented at the Annual Meeting of the Mid-South Educational Research Association, New Orleans, LA.

American College Testing. (2008). ACT High School Profile. Retrieved August 31, 2008, from http://act.org/news/data/08/pdf/three.pdf

Andre, T., Whigham, M., Hendrickson, A., & Chambers, S. (1997, March). *Science and mathematics versus other school subject areas: Pupil attitudes versus parent attitudes.* Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Chicago, IL.

Bailey, T., Jenkins, D., & Leinbach, T. (2005). Community college low income and minority student completion study: Descriptive statistics from the 1992 high school cohort. Retrieved November 26, 2010, from http://ccrc.tc.columbia.edu/Publication.asp?uid=206

Bailey, T., Jeong, D.W., & Cho, S.W. (2010). Referral, enrollment, and completion in developmental education sequences in community colleges. *Economics of Education Review, 29,* 225-270.

Bandura, A., Barbaranelli, C. Caprara, G. V., & Pastorelli, C. (1996). Multifaceted impact of self-efficacy beliefs on academic functioning. *Child Development, 67 (3),* 1206-1222.

Bassarear, T. (1986, April). *Attitudes and beliefs about learning, about mathematics, and about self which most seriously undermine performance in mathematics courses.* Paper presented at the Annual Conference of the New England Educational Research Organization, Rockport, ME.

Batzer, L. A. (1997). *The effect of remedial education programs on academic achievement and persistence at the two-year community college.* Doctoral dissertation, Western Michigan University. (ERIC Document Reproduction Service No. ED433867).

Bembenutty, H. & Zimmerman, B. J. (2003, April). *The relation of motivational beliefs and self-regulatory processes to homework completion and academic achievement.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Bessant, K. C. (1995). Factors associated with types of mathematics anxiety in college students. *Journal for Research in Math Education, 26 (4),* 327-345.

Betz, N. E. (1978). Prevalence, distribution, and correlates of math anxiety in college students. *Journal of Counseling Psychology, 26 (5),* 441-448.

Bitner, J., Austin, S. & Wadlington, E. (1994). A comparison of math anxiety in traditional and nontraditional developmental college students. *Research and teaching in developmental education, 10 (2),* 35-43.

Bohuslov, R. L. (1980). *A method for dealing with attitudes and anxieties in mathematics.* (ERIC Document Reproduction Service No. ED194158)

Boylan, H. R. (1999b). Harvard Symposium 2000: Developmental education: Demographics, outcomes, and activities. *Journal of Developmental Education, 23(2),* 2-8.

Boylan, H. R. (2002). What works: *Research based best practices in developmental education*. Boone, NC: Continuous Quality Improvement Network.

Boylan, H. R. & Saxon, D. P. (1999). Remedial courses: *Estimates of student participation and the volume of remediation in U.S. community colleges.* Retrieved July 5, 2008, from http://www.ncde.appstate.edu/reserve_reading/Remedial_Courses.htm

Brothen, T. & Wambach, C. (2000). A beneficial self-monitoring activity for developmental students. *Research and Teaching in Developmental Education, 17, (1),* 31-37.

Bureau of Labor Statistics (2008). *Occupational Outlook Handbook*. Retrieved July 5, 2008, from http://www.bls.gov/oco/oco2003.htm

Burley, H. (1994). *Persistence: A meta-analysis of college developmental studies programs.* New Orleans, LA: Paper presented at the Annual Forum of the Association for Institutional Research. (ERIC Document Reproduction Service No. ED 373855).

Cantwell, R. H. (1998). The development of beliefs about learning from mid- to late-adolescence. *Educational Psychology, 18 (1),* 27-40.

Casazza, M. E. & Silverman, S. L. (1996). *Learning assistance and developmental education: A guide for effective practice.* San Francisco, CA: Jossey Bass, Inc.

Chen, X. (2005). First generation students in postsecondary education: A look at their college transcripts. *National Center for Education Statistics: Postsecondary Education Descriptive Analysis Reports,* Retrieved November 30, 2006, from http://nces.ed.gov/pubs2005/2005171.pdf

Chouinard, R., Karsenti, T., & Roy, N. (2007). Relations among competence beliefs, utility value, achievement goals, and effort in mathematics. *British Journal of Educational Psychology, 77*, 501-517.

Cohen, J. (1998). *Statistical power analysis for the behavioral sciences (2^{nd} ed.).* New York: John Wiley.

Cohen, A. M. & Brawer, F. B. (2003). *The American community college.* San Francisco, CA: Jossey Bass.

College Catalog (2010). Retrieved from the Community College website: http://www.butlercc.edu/Catalog/index.cfm

Cooper, S. E. & Robinson, D. (1991). The relationship of mathematics self-efficacy beliefs to math anxiety and performance. *Measurement & Evaluation in Counseling & Development*, *24 (1)*, 4-12.

Course Schedule (2009). Retrieved from the Community College website: http://www.butlercc.edu/interactive_schedule/results.cfm

Curtis, J. W. (2002). *Germanna Community College: Student outcomes in developmental education 1994-95 through 1999-2000.* (ERIC Document Reproduction Service No. ED 459900).

Crane, L. R., McKay, E. R. & Poziemski, C. (2002). *Pieces of the puzzle: Success of remedial and non-remedial students.* Ontario: Annual Meeting of the Association for Institutional Research. (ERIC Document Reproduction Service No. ED474034).

Drew, D. E. (1996). *Aptitude revisited.* Baltimore, MD: Johns Hopkins University Press.

Fennema, E. & Sherman, J. A. (1976). Fennema-Sherman Mathematics Attitudes Scales. Journal of Supplemental Abstract Service (JSAS) Catalog of Selected Documents in Psychology, 6 (1), 31.

Fennema, E. & Sherman, J. (1977). Sex-related differences in mathematics achievement, spatial visualization, and affective factors. *American Educational Research Journal, 14 (1),* 51-71.

Garavalia, L. & Ray, M. (2003). Distinctions among subgroups of developmental students: Differences in task value, self-regulated learning, and grade expectations. *Research & Teaching in Developmental Education, 19 (2),* 29-40.

Gerlaugh, K., Thompson, L., Boylan, H. & Davis, H. (2007). National study of developmental education II: Baseline data for community colleges. *Research in Developmental Education, 20 (4),* 1-4.

Godbey, C. (1997). Mathematics anxiety and the underprepared student. ERIC Document Reproduction Service No. ED426734.

Gourgey, A. F. (1984, April). *The relationship of misconceptions about math and mathematical self-concept to math anxiety and statistics performance.* Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Gravetter, F. J. & Wallnau, L. B. (2005). Essentials of statistics for the behavioral sciences. Belmont, CA: Wadsworth.

Green, L. T. (1990). Test anxiety, mathematics anxiety, and teacher comments: Relationships to achievement in remedial mathematics classes. *The Journal of Negro Education, 59 (3),* 320-335.

Greene, B. A., DeBacker, T. K., Ravindran, B. & Krows, A. J. (1999). Goals, values, and beliefs as predictors of achievement and effort in high school mathematics classes. *Sex Roles, 40 (5/6),* 421-458.

Grimes, S. K. & David, K. C. (1999). Underprepared community college students: Implications of attitudinal and experiential differences. *Community College Review, 27 (2),* 73-92.

Hearn, J. C. & Holdsworth, J. M. (2004). Federal Student Aid: The Shift from Grants to Loans. In E. P. St. John & M. D. Parsons (Eds.), *Public Funding of Higher Education* (pp. 40-59). Baltimore, MD: The Johns Hopkins University Press.

Hembree, R. (1990). The nature, effects, and relief of math anxiety. *Journal for Research in Mathematics Education, 21 (1),* 33-46.

Ho, H., Senturk, D., Lam, A. G., Zimmer, J. M., Hong, S., Okamoto, Y., Chiu, S., Nakazawa, Y., & Wang, C. (2000). The affective and cognitive dimensions of math anxiety: A cross-national study. *Journal for Research in Mathematics Education, 31 (3),* 362-379.

Hoyt, J. E. & Sorensen, C. T. (2001). High school preparation, placement testing, and college remediation. *Journal of Developmental Education,* 25 2), 26-33.

Huck, S. W. and Cormier, W. H. (1996). *Reading statistics and research.* New York: HarperCollins Publishers.

Ikegulu, T. N. (2000). The differential effects of gender and mathematics anxiety apprehension on developmental students' academic performance and persistence. ERIC Document Reproduction Service No. ED451824.

Ikegulu, T. N. (1998). An empirical development of an instrument to assess math anxiety and apprehension. ERIC Document Reproduction Service No. ED433235.

Kazelskis, R., Reeves, C., Kersch, M. E., Bailey, G., Cole, K., Larmon, M., Hall, L., & Holliday, D. C. (2000). Mathematics anxiety and test anxiety: Separate constructs? *The Journal of Experimental Education, 68 (2),* 137-146.

Keif, M. G. & Stewart, B. R. (1996). A study of instruction in applied mathematics: Student performance and perception. *Journal of vocational education research, 21 (3),* 31-48.

Kincaid, M. B. & Austin-Martin, G. (1981, January). *Relationship between math attitudes and achievement, parents' occupation, and math anxiety in female college freshmen.* Paper presented at the Annual Meeting of the American Educational Research Association, Dallas, TX.

Kitchens, A. N. (1995). *Defeating math anxiety.* Chicago, IL: Richard D. Irwin, Inc.

Levine-Brown, P., Bonham, B. S., Saxon, D. P., & Boylan, H. R. (2008). Affective assessment for developmental students, Part 2. *Research in Developmental Education,* 22 (2), 1-4.

Ley, K. & Young, D. B. (1998). Self-regulation behaviors in underprepared (developmental) and regular admission college students. *Contemporary Educational Psychology, 23,* 42-64.

Linnenbrink, E. A. & Pintrich, P. R. (2002). Motivation as an enabler for academic success. *The School Psychology Review, 31 (3),* 313-327.

Linnenbrink, E. A. & Pintrich, P. R. (2004). Role of affectin cognitive processing in academic contexts. In D. Y. Dai & R. J. Sternberg (Eds.), *Motivation, emotion, and cognition: Integrative perspectives on intellectual functioning and development* (pp. 57-87). Mahwah, NJ: Lawrence Erlbaum Associates.

Livingston, A. & Wirt, J. (2004). *The Condition of Education 2004 in Brief* (NCES 2004-076). National Center for Education Statistics, U. S. Department of Education. Washington, D. C.: U. S. Government Printing Office.

Ma, X. (1999). A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. *Journal for Research in Mathematics Education, 30 (5),* 520-540.

Ma, X. (1997). Reciprocal relationships between attitude toward mathematics and achievement in mathematics. *The Journal of Educational Research, 90,* 221-229.

Ma, X. & Cartwright, F. (2003). A longitudinal analysis of gender differences in affective outcomes in mathematics during middle and high school. *School Effectiveness and School Improvement, 14 (4),* 413-439.

McCabe, R. H. (2000). *No one to waste: A report to public decision-makers and community college leaders.* Washington, DC: Community College Press.

McCusker, M. (1999). Effective elements of developmental reading and writing programs. *Community College Review, 27(2)*, 93-105.

McLeod, D. B. (1989). Beliefs, attitudes, and emotions: New views of affect in math education. In D. B. McLeod & V. M. Adams (Eds.), *Affect and mathematical problem-solving* (pp. 245-258). New York: Springer-Verlag.

McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 575-596). New York: Macmillan.

McLeod, D. B. (1994). Research on affect and mathematics learning in the JRME: 1970 to the Present. *Journal for Research in Math Education, 24 (6)*, 637-647.

Mealey, D. L. (1990). Understanding the motivation problems of at-risk college students. *Journal of Reading. Vol/#????,* 598-601.

Middleton, M. J. & Midgley, C. (1997). Avoiding the demonstration of lack of ability: An underexplored aspect of goal theory. *Journal of Educational Psychology, 89 (4)*, 710-718.

Miller, N. C. (2000). *Perceptions of motivation in developmental math students: I would rather drill my own teeth.* Doctoral dissertation, University of Texas, Austin. (ERIC Document Reproduction Service No. ED457911)

National Center for Developmental Education (2008). *Developmental Education.* Retrieved September 3, 2008, from http://www.ncde.appstate.edu/

National Center for Education Statistics (2000). *Condition of education.* Retrieved May 13, 2006 from http://nces.ed.gov

National Center for Education Statistics (2003). *Condition of education.* Retrieved May 13, 2006 from http://nces.ed.gov

Nolting, P. (2007). *Winning at math* (5th ed.). Bradenton, FL: Academic Success Press, Inc.

Nota, L., Soresi, S. & Zimmerman, B. J. (2004). Self-regulation and academic achievement and resilience: A longitudinal study. *International Journal of Educational Research, 41,* 198-215.

Op't E. & De Corte, E. (2003, April). *Students' mathematics-related belief systems: Design and analysis of a questionnaire.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

Organizational Overview. (2008). *Organizational Overview.* Retrieved March 15, 2009, from ir.butlercc.edu/parts/organizational_overview.pdf

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66 (4),* 543-578.

Pajares, F. (2002). Gender and perceived self-efficacy in self-regulated learning. *Theory Into Practice, 41 (2),* 116-125.

Pedhazur, E. J. (1997). *Multiple regression in behavioral research: Explanation and prediction.* Fort Worth, TX: Harcourt College Publishers.

Pedersen, K. (1985). *Affective and cognitive mathematics related variables: A longitudinal study*. (ERIC Document Reproduction Service No. ED 265011)

Performance Agreement (2009). Retrieved from the Community College, Institutional Research website: http://ir.butlercc.edu/parts/ KBOR%20PA/ Butler_CCC_9-2009.pdf

Peskoff, F. (2000, July). *Mathematics anxiety and the adult student: An analysis of successful coping strategies.* Paper presented at the International Conference on Adults Learning Mathematics, Medford, MA.

Pintrich, P. R. (2000a). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology, 92, (3),* 544-555.

Pintrich, P. R. (2000b). The role of goal orientation in self-regulated learning. In Boekaerts, M., Pintrich, P., & Zeidner, M. (2000). *Handbook of self-regulation* (pp. 452-502). San Diego, CA: Academic Press.

Pintrich, P. R. & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82 (1),* 33-40.

Pintrich, P. R. & Garcia, T. (1994). Self-regulated learning in college students: Knowledge, strategies, and motivation. In P. R. Pintrich, D. R. Brown, & C. E. Weinstein (Eds.), *Student Motivation, Cognition, and Learning* (pp. 113-134). Hillsdale, NJ: Lawrence Erlbaum Associates.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire.* Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning. (ERIC Document Reproduction Service No. ED338112).

Provasnik, S. & Planty, M. (2008). *Community Colleges: Special Supplement to the Condition of Education 2008* (NCES 2008-033). National Center for Education Statistics, Institute of Education Sciences, U. S. Department of Education. Washington, D. C.

Richardson, F. C. & Suinn, R. M. (1972). The Mathematics Anxiety Rating Scale (MARS): Psychometric data. *Journal of Counseling Psychology, 19 (6),* 551-554.

Ruban, L, McCoach, D. B., & Reis, S. M. (2002, April). *Gender invariance in the impacts of pre-college scholastic factors and self-regulated learning variables on the academic attainment of undergraduate students.* Paper presented at the annual convention of the American Educational Research Association, New Orleans, LA.

Ruban, L. & Nora, A. (2002, April). *Factors impacting the academic status of undergraduate students at four-year institutions.* Paper presented at annual convention of the American Educational Research Association, New Orleans, LA.

Ruffell, M., Mason, J., & Allen, B. (1998). Studying attitude to mathematics. *Educational Studies in Mathematics, 35 (1),* 1-18.

Saffer, N. (1999, Summer). Core subjects and your career. *Occupational Outlook Quarterly*, 26-40. Retrieved June 20, 2010, from www.bls.gov/opub/ooq/1999/Summer/art03.pdf

Saxon, D. P. & Boylan, H. R. (1999). Characteristics of community college remedial students. Appalachian State University, Retrieved from http://www.ced/appstate.edu/centers/ncde/researve_reading/student_characteristics.htm

Saxon, D. P., Levine-Brown, P., & Boylan, H. R. (2008). Affective assessment for developmental students, Part 1. *Research in Developmental Education*, 22 (1), 1-4.

Sedlacek, W. E. (2004). *Beyond the big test.* San Francisco, CA: Jossey-Bass.

Sherman, J. & Fennema, E. (1977). The study of mathematics by high school girls and boys: Related variables. *American Educational Research Journal, 14 (2),* 159-168.

Singh, K., Granville, M., & Dika, S. (2002). Math and science achievement: Effects of motivation, interest, and academic engagement. *Journal of Educational Research, 95 (6),* 323-332.

Stipek, D., Salmon, J. M., Givvin, K. B., and Kazemi, E. (1998). The value (and convergence) of practices suggested by motivation research and promoted by mathematics education reformers. *Journal for Research in Mathematics Education, 29 (4),* 465-488.

Tittle, C. K. & Hecht, D. (1992, July or April??). *A technology-based innovation to facilitate teacher access to and use of assessments of JHS students' self-regulatory, affective and motivational beliefs about mathematics.* Revised version of a paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Tobias, S. (1985). Test anxiety: Interference, defective skills, and cognitive capacity. *Educational Psychologist, 20,* 135-142.

Tobias, S. (1990). Math anxiety: An update. *National Academic Advising Association Journal, 10 (1),* 47-50.

Trainin, G. & Swanson, H. L. (2005). Cognition, metacognition, and achievement of college students with learning disabilities. *Learning Disability Quarterly, 28 (4),* 261-272.

Trawick, L. (1992, April). *Effects of a Cognitive-Behavioral Intervention on the Motivation, Volition, and Achievement of Academically Underprepared College Students.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Updegraff, K. A. & Eccles, J. S. (1996). Course enrollment as self-regulatory behavior: Who takes optional high school math courses? *Learning & Individual Differences, 8 (3),* 239-260.

Venezia, A, Kirst, M. W., & Antonio A. L. *Betraying the college dream: How disconnected K-12 and postsecondary education institutions undermine student aspirations* (2004). Retrieved May 13, 2006, from http://www.stanford.edu/group/bridgeproject/betrayingthecollegedream.pdf

Weissman, J., Silk, E., & Bulakowski, C. (1995). *Assessing developmental education through student tracking.* Boston, MA: Paper presented at the Annual Forum of the Association for Institutional Research. (ERIC Document Reproduction Service No. ED 386983).

Wirt, J., Choy, S., Rooney, P., Provasnik, S., Sen, A., Tobin, R. (2004). *The Condition of Education 2004* (NCES 2004-077). U. S. Department of Education, National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

York-Anderson, G. & Bowman, S. (1991). Assessing the knowledge of first-generation and second-generation college students. *Journal of College Student Development, 32,* 116-122.

Young, D. & Ley, K. (2005). Developmental college student self-regulation: Results from two measures. *Journal of College Reading & Learning, (1),* 60-80.

Zimmerman, B. J. (2000). Attaining self-regulation. In Boekaerts, M., Pintrich, P., & Zeidner, M. (2000). *Handbook of self-regulation* (pp. 13-39). San Diego, CA: Academic Press.

Zimmerman, B. J. (1998). Academic studying and the development of personal skill: A self-regulatory perspective. *Educational Psychologist, 33 (2/3),* 73-86.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25 (1),* 3-17.

Zimmerman, B. J. & Bandura, A. (1994). Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal, 31 (4),* 845-862.

Zimmerman, B. J. & Martinez-Pons, M. (1988). Construct validation of a strategy model of student self-regulated learning. *Journal of Educational Psychology, 80 (3),* 284-290.

Appendices

Appendix A - HSLC Approval

KU RESEARCH & GRADUATE STUDIES
The University of Kansas

2/11/2009
HSCL #17829

Cindy Otts
12615 W 110th Terrace
Overland Park, KS 66210

The Human Subjects Committee Lawrence reviewed your research update application for project

17829 Otts/Wolf-Wendel (ELPS) The Influence of Self-Regulatory & Attitudinal Factors on the Academic Performance of Students Enrolled in Developmental Math Courses

and approved this project under the expedited procedure provided in 45 CFR 46.110 (f) (7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

The Office for Human Research Protections requires that your consent form must include the note of HSCL approval and expiration date, which has been entered on the consent form sent back to you with this approval.

1. At designated intervals until the project is completed, a Project Status Report must be returned to the HSCL office.
2. Any significant change in the experimental procedure as described should be reviewed by this Committee prior to altering the project.
3. Notify HSCL about any new investigators not named in original application. Note that new investigators must take the online tutorial at http://www.rcr.ku.edu/hscl/hsp_tutorial/000.shtml.
4. Any injury to a subject because of the research procedure must be reported to the Committee immediately.
5. When signed consent documents are required, the primary investigator must retain the signed consent documents for at least three years past completion of the research activity. If you use a signed consent form, provide a copy of the consent form to subjects at the time of consent.
6. If this is a funded project, keep a copy of this approval letter with your proposal/grant file.

Please inform HSCL when this project is terminated. You must also provide HSCL with an annual status report to maintain HSCL approval. Unless renewed, approval lapses one year after approval date. If your project receives funding which requests an annual update approval, you must request this from HSCL one month prior to the annual update. Thanks for your cooperation. If you have any questions, please contact me.

Sincerely,

David Hann

David Hann
HSCL Coordinator

cc: Lisa Wolf-Wendel

Human Subjects Committee Lawrence
Youngberg Hall | 2385 Irving Hill Road | Lawrence, KS 66045 | (785) 864-7429 | Fax (785) 864-5049 | www.rcr.ku.edu/hscl

Appendix A
HSLC (Human Subjects Lawrence Campus) Status

From:	Human Subjects Committee	Sent:	Tue 2/2/2010 1:08 PM
To:	Otts, Cynthia Denise		
Subject:	RE: Human Participant Protection Training Tutorial Notice		

Dear Ms. Otts,

Thank you for your response! And as you have indicated, your human subject protection training is valid for three years from 1/26/2010.

Best,

Megan Pierce
HSCL Student Hourly

From: Otts, Cynthia Denise
Sent: Tuesday, January 26, 2010 9:11 PM
To: Human Subjects Committee
Subject: RE: Human Participant Protection Training Tutorial Notice

I completed the human subjects tutorial on 1/26/2010. If you need any additional information, please let me know.

Thank you,
Cindy Otts

From: Human Subjects Committee
Sent: Tue 1/26/2010 12:19 PM
To: Otts, Cynthia Denise
Subject: Human Participant Protection Training Tutorial Notice

Dear Human Participant Researcher:

HSCL's records indicate that more than three years have passed since you have taken the human participant protection training tutorial.

You must retake the online tutorial for conducting research involving human subjects before your project can receive HSCL approval or renewal of approval. The tutorial must be retaken every three years. You may access the tutorial at: http://www.rcr.ku.edu/hscl/hsp_tutorial/000.shtml

Notify HSCL when you have completed the tutorial.

Mary Denning
Coordinator
mdenning@ku.edu

864-7429

From:	Otts, Cynthia Denise	Sent:	Sun 1/24/2010 10:26 PM
To:	Human Subjects Committee		
Cc:	Otts, Cynthia Denise		
Subject:	RE: February Status Report - Exp		

Below you will find my status report concerning my project (HSCL # 17829), Please let me know if you need any additional information.

Cindy Otts

From: Human Subjects Committee
Sent: Fri 1/22/2010 11:27 AM
To: Otts, Cynthia Denise
Subject: February Status Report - Exp

Date: 1/22/2010

PROJECT STATUS REPORT

Mary Denning
HSCL - University of Kansas
Youngberg Hall
Lawrence, KS 66045
Tel. 785/864-7429
FAX 785/864-5049
mdenning@ku.edu

Federal law requires that all research projects approved by HSCL be monitored annually. Classroom projects and training grants should update their projects every semester. Therefore, it is crucial that you submit this form to HSCL at the appropriate time. IF WE DO NOT RECEIVE A STATUS REPORT, HSCL APPROVAL WILL NOT BE CONTINUED AND YOU MUST STOP DATA COLLECTION UNTIL YOU RECEIVE HSCL APPROVAL. All funding sources require a status report annually; however, HSCL does not send out an updated approval letter unless the primary investigator requests one (#4 below). If you have completed your project, please send the status form in so we can make your file inactive.

Please return this completed form to HSCL prior to your project approval anniversary date, 2/11/2009.

The status of my project, HSCL # 17829 - The Influence of Self-Regulatory & Attitudinal Factors on the Academic Performance of Students Enrolled in Developmental Math Courses, is checked as follows.

______1. The project has been completed. _______ check if funding continues.
___X_ 2. The project is still in operation but no significant changes are planned.
______3. Changes are requested in the approved procedures and a description of

the changes are attached. Please send me an updated approval letter.

______4. An update approval letter is requested for continuation of funding or for my own records.

Cindy Otts
Investigator's Signature
Cindy Otts
12615 W 110th Terrace
Overland Park, KS 66210

Return by e-mail to hscl@ku.edu or fax to 864-5049.

Appendix B

Approval to Conduct Study at the Community College

From:	Bethany A Chandler [bchandle@butlercc.edu]	Sent:	Fri 2/20/2009 9:57 AM
To:	Otts, Cynthia Denise		
Subject:	Research Study		

Cindy,

Hi, well I'm not Larry or Donna, they may be contacting you as well. However, my name is Bethany Chandler and I teach developmental math courses at [the community college] and am currently the curriculum specialist for a title 3 grant that we received. The research you are conducting would fit nicely with the research we are currently doing with our developmental math students. Are you willing to share the results of your survey with us as well? I will be happy to work with you to conduct your research at [the community college]. I will be gone to the NADE conference next week. I'm sure I will still have access to my e-mail, but if you would like to call me, you might try today or wait til the first of March.

Thanks,

Bethany Chandler
Math Instructor
316-322-3238

From:	Lori Ann Winningham [lwinning@butlercc.edu]	Sent:	Fri 2/20/2009 8:35 AM
To:	Otts, Cynthia Denise		
Subject:	Re: Research Study		

Cynthia,

I will forward this to the Lead Mathematics Instructors for them to connect with you about the possibility of working with you on this. We have a Title 3 grant going on right now that this research project may compliment nicely. I would want to tie it to some of that work.

Expect to hear from Larry Friesen and Donna Gorton.

Lori

Otts, Cynthia Denise wrote:

Dean Winningham:

Susan Bradley recommended that I contact you concerning my dissertation research. I would like to see about the possibility of conducting the research at the Community College. I am researching factors that influence the success of community college students enrolled in developmental math. Specifically, the study addresses whether self-directed learning strategies and attitudes toward math (math anxiety and perceived usefulness of math) relate to course success. The study focuses only on student attitudes and behaviors, so it is not meant to be an assessment of developmental courses, instructional strategies, etc.

KU's Human Subjects Board has approved the study. I need to have approximately 200 participants, and I would like to focus on one (or possibly two) developmental math courses--perhaps Pre-algebra or Fundamentals of Algebra. The study would involve administering a survey to students concerning their attitudes and learning strategies. I anticipate that it would take students about 20 minutes to take the survey. I am willing to conduct the survey or to provide the materials to course faculty so they can administer the survey if that is more convenient. Ideally, I would like to conduct the research in March/April. At the end of the semester, I would need to collect the grades that the participants earned in their respective math courses. All participants would need to sign a consent form allowing me to have access to that information. I would also need to collect some data about developmental math courses (i.e., placement, enrollment, course success rates) as background information. I would be glad to provide you with a report of the findings.

Please let me know if it would be possible to conduct this study at the Community College. I would happy to talk with you or provide any additional information. Thank you very much for your consideration. I look forward to hearing from you.

Cindy Otts
Doctoral Student
University of Kansas
Educational Leadership & Policy Studies
913) 271-8884

Appendix C
Survey Administration Instructions (Summer 2009)

June 10, 2009

Developmental Math Instructor:

Thank you for allowing your class to participate in this research project. The study ties in with the curricular changes that are being implemented as part of the Title III developmental math pilots. This study concerns the influence of math attitudes and study strategies on success (i.e., course completion, withdrawal) in developmental math. Students will be asked to complete a questionnaire and sign a consent form. (The questionnaire and consent forms are provided in the enclosed envelope.) The results of the study will be made available to faculty, staff, and students; however, individual student responses will be kept confidential. Results may be used for Title III reporting as well.

The questionnaire should take about 10-15 minutes for students to complete. You may administer the surveys during class at your convenience. The questionnaire should be administered between June 22-July10. If you have any questions about the study, please feel free to contact Cindy Otts (**cotts@ku.edu** or 913-451-9478) or Bethany Chandler (**bchandle@butlercc.edu**), the Community College's faculty coordinator for the Title III math pilots.

Instructions for Administering the Survey

- Administer the study between **June 22 – July 10**.
- Read the following statement to students immediately prior to administering the survey:

  This class is participating in a study about how learning strategies and attitudes toward math influence student success in developmental math courses. I am going to hand out a survey with questions about your learning strategies and attitudes toward math. You will also receive a consent form. Please sign the consent form and answer the items on the survey. The survey will take about 10-15 minutes to complete. Please answer the questions honestly. There are no right or wrong answers.

  Your responses will be kept confidential, and they will not affect your grade in this class. When you are finished, please hand in your completed questionnaire and consent form. You will receive a copy of the consent form for your records.

- Distribute the surveys and consent forms. A consent form that needs to be completed by the student is attached to the survey (green). The consent forms on white paper are for the students' records.
- Collect the completed surveys. Please double check to be sure that students completed the survey and signed the attached (green) consent form.
- Place the surveys (with attached consent forms) in the manila envelope that is provided. (Information on the labels of the manila envelopes is for tracking purposes only.)
- Please return the manila envelope with completed surveys and consent forms through campus mail to Bethany Chandler (El Dorado Campus).

Thank you for your participation!

Cindy Otts, KU Doctoral Student, Educational Leadership & Policy Studies

Appendix C
Survey Administration Instructions (Fall 2009)

September 25, 2009

Developmental Math Instructor:

Thank you for allowing your class to participate in this research project. The study ties in with the curricular changes that are being implemented as part of the Title III developmental math pilots. This study concerns the influence of math attitudes and study strategies on success (i.e., course completion, withdrawal) in developmental math. Students will be asked to complete a questionnaire and sign a consent form. (The questionnaire and consent forms are provided in the enclosed envelope.) The results of the study will be made available to faculty, staff, and students; however, individual student responses will be kept confidential. Results may be used for Title III reporting as well.

The questionnaire should take about 10-15 minutes for students to complete. You may administer the surveys during class at your convenience. The questionnaire should be administered between October 5 – October 24. If you have any questions about the study, please feel free to contact Cindy Otts (**cotts@ku.edu** or 913-451-9478) or Bethany Chandler (**bchandle@butlercc.edu**), the Community College's faculty coordinator for the Title III math pilots.

Instructions for Administering the Survey

- Administer the study between **October 5 – October 24**.
- Read the following statement to students immediately prior to administering the survey:

  This class is participating in a study about how learning strategies and attitudes toward math influence student success in developmental math courses. I am going to hand out a survey with questions about your learning strategies and attitudes toward math. You will also receive a consent form. Please sign the consent form and answer the items on the survey. The survey will take about 10-15 minutes to complete. Please answer the questions honestly. There are no right or wrong answers.

  Your responses will be kept confidential, and they will not affect your grade in this class. When you are finished, please hand in your completed questionnaire and consent form. You will receive a copy of the consent form for your records.

- Distribute the surveys and consent forms. A consent form that needs to be completed by the student is attached to the survey (green). The consent forms on white paper are for the students' records.
- Collect the completed surveys. Please double check to be sure that students completed the survey and signed the attached (green) consent form.
- Place the surveys (with attached consent forms) in the manila envelope that is provided. (Information on the labels of the manila envelopes is for tracking purposes only.)
- Please return the manila envelope with completed surveys and consent forms through campus mail to Bethany Chandler (El Dorado Campus).

Thank you for your participation!

Cindy Otts, KU Doctoral Student, Educational Leadership & Policy Studies

Appendix D
Informed Consent

Approved by the Human Subjects Committee Lawrence Campus, University of Kansas. Approval expires one year from 2/11/2009. HSCL #17829

Study Strategies and Math Attitudes of Developmental Math Students

CONSENT FORM

The purpose of this project is to determine how learning strategies and math attitudes influence the academic success of community college students enrolled in developmental math courses. The study is being conducted by a doctoral student enrolled in the Educational Leadership & Policy Studies program at the University of Kansas, as part of a dissertation project.

Participants in this project will complete a survey that has three sections: demographic, academic self-regulation (motivation and learning strategies), and math attitudes. The survey will take approximately 15 minutes to complete. The following paragraphs provide important information about participation in this project.

I, ________________________________, agree to participate in this study.
Participant's name (please print)

Participation
I agree to answer the survey items honestly. I understand that participation in the study will not affect my grade in the course. I understand that there are no risks related to my participation in this project. I also understand that my participation is voluntary and that I may withdraw from the project at any time.

Confidentiality
I understand that all information collected about me (including my name) as part of the study will be kept confidential. Individual student responses will not be disclosed to anyone and will not appear in the report. I understand that after this information is collected, it will be kept in a secure location that only the researcher and the faculty advisor(s) can access.

Other
I allow the college to release my final course grade for this math class to the researcher to be used only for the purpose of this study. I understand that if I have any questions about this project, I may contact the researcher or the faculty advisor (see contact information below). If I have any additional questions about my rights as a participant in this project, I may call (785-864-7429), email (**dhann@ku.edu**) or write the Human Subjects Committee Lawrence Campus, University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563.

By signing below, I affirm that I understand the information outlined above, and I agree to participate in this research study. I also acknowledge that I received a copy of this consent form.

Participant's Signature: ____________________________ Date: _____________

Researcher:

Cindy Otts, Doctoral Student
University of Kansas
Educational Leadership & Policy Studies
Joseph R. Pearson Hall
University of Kansas
Lawrence, KS 66045
(913) 451-9478
cotts@ku.edu

Faculty Advisor:

Dr. Lisa Wolf-Wendel, Professor/Advisor
University of Kansas
Educational Leadership & Policy Studies
Joseph R. Pearson Hall
University of Kansas
Lawrence, KS 66045
(785) 864-9722
lwolf@ku.edu

Appendix E
Survey Instrument

Learning Strategies

The following questions ask you about your leaning strategies and study skills for this class. There are no right or wrong answers. Answer the questions about how you study in this math class. Circle 7 if the statement is very true of you. If a statement is not at all true of you, circle 1. If you are somewhere in between, circle the number that best describes how true the statement is of you.

	Not at all true of me						**Very true of me**
1. During class time I often miss important points because I'm thinking of other things.	1	2	3	4	5	6	7
2. When studying for this course, I often try to explain the material to a classmate or friend.	1	2	3	4	5	6	7
3. I usually study in a place where I can concentrate on my course work.	1	2	3	4	5	6	7
4. I often quit studying for math before I am done with assignments because I get bored or frustrated.	1	2	3	4	5	6	7
5. When I study for this class, I practice solving math problems over and over.	1	2	3	4	5	6	7
6. Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.	1	2	3	4	5	6	7
7. When I have trouble solving a math problem, I go back and try to figure it out.	1	2	3	4	5	6	7
8. When I study for math, I go through my notes and the text book and try to identify the most important types of problems and concepts.	1	2	3	4	5	6	7
9. I make good use of my study time for this course.	1	2	3	4	5	6	7
10. If something in math is really hard to understand, I change the way I study.	1	2	3	4	5	6	7
11. I try to work with other students from this class to complete the course assignments.	1	2	3	4	5	6	7
12. When I study for math, I review my notes, homework assignments, and/or sample math problems over and over.	1	2	3	4	5	6	7
13. I work hard to do well in math even if I don't like it.	1	2	3	4	5	6	7
14. I make simple charts, diagrams, or pictures to help me solve math problems.	1	2	3	4	5	6	7
15. When studying for this course, I often work with another student(s).	1	2	3	4	5	6	7
16. I find it hard to stick to a study schedule.	1	2	3	4	5	6	7
17. When I study for this class, I pull together information from different sources, such as lectures, class notes, and the textbook.	1	2	3	4	5	6	7
18. I ask myself questions to make sure I understand the material I have been studying in this class.	1	2	3	4	5	6	7
19. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.	1	2	3	4	5	6	7

	Not at all true of me						Very true of me
20. During class time, I often think of other things and do not really listen to what my instructor says.	1	2	3	4	5	6	7
21. I ask my math instructor to explain problems or concepts that I do not understand well.	1	2	3	4	5	6	7
22. I memorize key equations or formulas that I need to know for tests.	1	2	3	4	5	6	7
23. When math work is hard, I give up or only study the easy parts.	1	2	3	4	5	6	7
24. I try to relate math topics to ideas from other courses.	1	2	3	4	5	6	7
25. When I study for math, I go over my class notes and the textbook and write down important concepts or equations.	1	2	3	4	5	6	7
26. I try to relate material from math class to what I already know.	1	2	3	4	5	6	7
27. I have a regular place set aside for studying.	1	2	3	4	5	6	7
28. When I can't understand the material in this course, I ask someone else for help.	1	2	3	4	5	6	7
29. I keep up with homework and other assignments for this class.	1	2	3	4	5	6	7
30. I attend this class regularly.	1	2	3	4	5	6	7
31. Even when math homework is boring, I keep working until I finish.	1	2	3	4	5	6	7
32. I try to find someone in this class whom I can ask for help when I need it.	1	2	3	4	5	6	7
33. In math, I keep track of how much I understand the work, not just if I am getting the right answers.	1	2	3	4	5	6	7
34. I often find that I don't spend very much time on this course because of other activities.	1	2	3	4	5	6	7
35. Before I start studying for math, I decide what I want to accomplish during my study time.	1	2	3	4	5	6	7
36. If I get confused in class, I make sure I sort it out afterwards.	1	2	3	4	5	6	7
37. I rarely review my notes or homework assignments before tests.	1	2	3	4	5	6	7

Math Attitudes

The following questions ask you about your attitudes toward math. There are no right or wrong answers. Please circle the response that best describes your attitude. You may choose from the following answers: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), or Strongly Disagree (SD).

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. I'll need mathematics for my future work.	SA	A	U	D	SD
2. I study mathematics because I know how useful it is.	SA	A	U	D	SD
3. In terms of my adult life it is not important for me to do well in mathematics in school.	SA	A	U	D	SD
4. Mathematics will not be important to me in my life's work.	SA	A	U	D	SD
5. Knowing mathematics will help me earn a living.	SA	A	U	D	SD
6. Taking mathematics is a waste of time.	SA	A	U	D	SD

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
7. Mathematics is of no relevance to my life.	SA	A	U	D	SD
8. Mathematics is a worthwhile and necessary subject.	SA	A	U	D	SD
9. I see mathematics as a subject I will rarely use in my daily life as an adult.	SA	A	U	D	SD
10. I will use mathematics in many ways as an adult.	SA	A	U	D	SD
11. I'll need a firm mastery of mathematics for my future work.	SA	A	U	D	SD
12. I expect to have little use for mathematics when I get out of school.	SA	A	U	D	SD
13. I haven't usually worried about being able to solve math problems.	SA	A	U	D	SD
14. It wouldn't bother me at all to take more math courses.	SA	A	U	D	SD
15. Mathematics usually makes me feel uncomfortable and nervous.	SA	A	U	D	SD
16. My mind goes blank and I am unable to think clearly when working mathematics.	SA	A	U	D	SD
17. Math doesn't scare me at all.	SA	A	U	D	SD
18. I usually have been at ease in math classes.	SA	A	U	D	SD
19. I get a sinking feeling when I think of trying hard math problems.	SA	A	U	D	SD
20. Mathematics makes me feel uncomfortable, restless, irritable, and impatient.	SA	A	U	D	SD
21. A math test would scare me.	SA	A	U	D	SD
22. Mathematics makes me feel uneasy and confused.	SA	A	U	D	SD
23. I usually have been at ease during math tests.	SA	A	U	D	SD
24. I almost never have gotten shook up during a math test.	SA	A	U	D	SD

Please provide the following information about yourself:

Gender: ☐ Male ☐ Female

Ethnicity: (Check one.)

☐ American Indian or Alaska Native
☐ Asian
☐ Black or African American
☐ Latino/Hispanic
☐ Native Hawaiian or Other Pacific Islander
☐ White
☐ Multiracial
☐ Other (please specify____________________)

College Enrollment: ☐ Full-time (12 or more credit hours) ☐ Part-time (1-11 credit hours)

Employment: How many hours per week do you usually work? ___________

Age: __________

Marital Status: ☐ Single ☐ Married ☐ Divorced/Separated

Children: How many children do you have who live with you? ________

What is the education level of your parent(s)?

Mother	Father
☐ Less than high school	☐ Less than high school
☐ High school diploma/GED	☐ High school diploma/GED
☐ Some college	☐ Some college
☐ Bachelor's degree	☐ Bachelor's degree
☐ Graduate or professional degree	☐ Graduate or professional degree
☐ Unknown	☐ Unknown

Basic Skills Coursework: Are you enrolled in (or have you taken) the following courses?

a)	Developmental/remedial writing	☐ Yes	☐ No	☐ Don't Know
b)	Developmental/remedial reading	☐ Yes	☐ No	☐ Don't Know
c)	Lower level developmental math	☐ Yes	☐ No	☐ Don't Know

Student ID Number: ____________________

Name: (PLEASE PRINT.)

____________________	____________________	________
First Name	Last Name	Middle Initial

Appendix F

Permission to Use Survey Instruments

From:	Elizabeth Fennema [efennema@wisc.edu]	Sent:	Mon 9/29/2008 7:43 PM
To:	Otts, Cynthia Denise		
Subject:	Re: FW: Permission to use the Fennema-Sherman Math Attitudes Scales		

Otts, Cynthia Denise wrote:

Dr. Fennema,

I am writing concerning use of the Fennema-Sherman Math Attitudes Scales for my dissertation. You had suggested (in a previous email dated 8/26/08) that I contact the Wisconsin Center for Educational Research to request permission to use the scales, which I did. Gwen Goplin referred me back to you, as the editor was unable to find any record of previous requests to use the scales. Below is the reply that I received.

For my dissertation, I am studying math attitudes and academic self-regulation among students enrolled in developmental math courses. I am particularly interested in using the Math Anxiety and Usefulness of Mathematics Scales. Could you please let me know if I can have your permission to use the scales? If you have any questions about the research, I would be happy to provide additional information. Thank you for your consideration. I look forward to hearing from you.

Thank you,

Cindy Otts
Doctoral Student, Educational Leadership & Policy Studies
University of Kansas

____

From: Gwen Goplin [**mailto:gjgoplin@wisc.edu**]
Sent: Mon 9/29/2008 4:51 PM
To: Otts, Cynthia Denise
Subject: Permission to use the Fennema-Sherman Math Attitude Scales

I checked with our WCER's editor who keeps permission rights. She thinks that Elizabeth Fennema, as one of the authors, would be in a position to grant permission. The WCER's editor commented she has a complete file of requests for permission to use WCER publications, but sees no record of any previous request to use the Fennema/Sherman math attitudes scales. A search of the Web indicates that the scales date from 1976. So we can't grant you that permission. So contacting Elizabeth Fennema would probably be your best solution.
Thanks.
Gwen

Gwen Goplin

Accountant Journey
University of Wisconsin
Wisconsin Center for Education Research
(608) 263-4251
gjgoplin@wisc.edu

You have my permisssion to use the Fennema-Sherman Mathematics Attitude Scales for your dissertation research provided you reference them adequately.

Elizabeth Fennema

From:	Bill McKeachie [billmck@umich.edu]	Sent:	Mon 9/29/2008 12:20 PM
To:	Otts, Cynthia Denise		
Subject:	Re: MSQL Questionnaire		

Dear Cynthia, You are very welcome to use and adapt the MSLQ in any way to meet your needs. Good luck with your dissertation!

Bill McKeachie

P.S. I'd be grateful for a copy of the dissertation abstract when you finish.

On Sep 28, 2008, at 6:27 PM, Otts, Cynthia Denise wrote:

Dr. McKeachie,

I am a doctoral student in the Educational Leadership and Policy Studies program at the University of Kansas. For my dissertation, I am studying math attitudes and self-regulatory skills among students enrolled in developmental math courses.

I am requesting your permission to use the Motivated Strategies for Learning Questionnaire for my dissertation. Given time constraints for administering the survey and the parameters of the study, I would need to reduce the number of questions and modify the items slightly to reflect the students and subject matter.

Would you be willing to grant me permission to adapt the survey for my dissertation? If you desire, I would be happy to send you a copy of the survey for your review. If you have any questions about the research, I would be happy to answer them. Thank you for your consideration. I look forward to hearing from you.

Thank you,

Cindy Otts
Doctoral Student, University of Kansas

Appendix G
Modifications to MSLQ Items

Item #	MSLQ Item	Revised Item	MSLQ Item #
1	During class time I often miss important points because I'm thinking of other things.		33
2	When studying for this course, I often try to explain the material to a classmate or friend.		34
3	I usually study in a place where I can concentrate on my course work.		35
4	I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	I often quit studying for math before I am done with assignments because I get bored or frustrated.	37
5	When I study for this class, I practice saying the material to myself over and over.	When I study for this class, I practice solving math problems over and over.	39
6	Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.		40
7	When I become confused about something I'm reading for this class, I go back and try to figure it out.	When I have trouble solving a math problem, I go back and try to figure it out.	41
8	When I study for this course, I go through the readings and my class notes and try to find the most important ideas.	When I study for math, I go through my notes and the text book and try to identify the most important types of problems and concepts.	42
9	I make good use of my study time for this course.		43
10	If course readings are difficult to understand, I change the way I read the material.	If something in math is really hard to understand, I change the way I study.	44
11	I try to work with other students from this class to complete the course assignments.		45
12	When studying for this course, I read my class notes and the course readings over and over again.	When I study for math, I review my notes, homework assignments, and/or sample math problems over and over.	46
13	I work hard to do well in this class even if I don't like what we are doing.	I work hard to do well in math even if I don't like it.	48
14	I make simple charts, diagrams, or tables to help me organize course material.	I make simple charts, diagrams, or pictures to help me solve math problems.	49
15	When studying for this course, I often set aside time to discuss course material with a group of students from the class.	When studying for this course, I often work with another student(s).	50
16	I find it hard to stick to a study schedule.		52

17	When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.	When I study for this class, I pull together information from different sources, such as lectures, class notes, and the textbook.	53
18	I ask myself questions to make sure I understand the material I have been studying in this class.	I test myself to check my understanding of what I have been studying.	55
19	I try to change the way I study in order to fit the course requirements and the instructor's teaching style.		56
20	I often find that I have been reading for this class but don't know what it was all about.	During class time, I often think of other things and do not really listen to what my instructor says.	57
21	I ask the instructor to clarify concepts I don't understand well.	I ask my math instructor to explain problems or concepts that I do not understand well.	58
22	I memorize key words to remind me of important concepts in this class.	I memorize key equations or formulas that I need to know for tests.	59
23	When course work is difficult, I either give up or only study the easy parts.	When math work is hard, I give up or only study the easy parts.	60
24	I try to relate ideas in this subject to those in other courses whenever possible.	I try to relate math topics to ideas from other courses.	62
25	When I study for this course, I go over my class notes and make an outline of important concepts.	When I study for math, I go over my class notes and the textbook and write down important concepts or equations.	63
26	When reading for this class, I try to relate the material to what I already know.	I try to relate material from math class to what I already know.	64
27	I have a regular place set aside for studying.		65
28	When I can't understand the material in this course, I ask another student in this class for help.	When I can't understand the material in this course, I ask someone else for help.	68
29	I make sure that I keep up with the weekly readings and assignments for this course.	I keep up with homework and other assignments for this class.	70
30	I attend this class regularly.		73
31	Even when course materials are dull and uninteresting, I manage to keep working until I finish.	Even when math homework is boring, I keep working until I finish.	74
32	I try to identify students in this class whom I can ask for help if necessary.	I try to find someone in this class whom I can ask for help when I need it.	75
33	When studying for this course I try to determine which concepts I don't understand well.	In math, I keep track of how much I understand the work, not just if I am getting the right answers.	76
34	I often find that I don't spend very much time on this course because of other activities.		77
35	When I study for this class, I set goals for myself in order to direct my activities in each study period.	Before I start studying for math, I decide what I want to accomplish during my study time.	78
36	If I get confused taking notes in class, I make sure I sort it out afterwards.	If I get confused in class, I make sure I sort it out afterwards.	79
37	I rarely find time to review my notes or readings before an exam.	I rarely review my notes or homework assignments before tests.	80

	When I study the readings for this course, I outline the material to help me organize my thoughts.		32
	When reading for this course, I make up questions to help focus my reading.		36
	I often find myself questioning things I hear or read in this course to decide if I find them convincing.		38
	When a theory, interpreation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.		47
	I treat the course material as a starting point and try to develop my own ideas about it.		51
	Before I study new course material thoroughly, I often skim it to see how it is organized		54
	I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.		61
	I try to play around with ideas of my own related to what I am learning in this course.		66
	When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.		67
	I try to understand the material in this class by making connections between the readings and the concepts from the lectures.		69
	Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.		71
	I make lists of important items for this course and memorize the lists.		72
	I try to apply ideas from course readings in other class activities such as lecture and discussion.		81

Appendix H
Chi Square Analyses: Comparison of Study Sample
with Students for Whom Final Grades Were Received

Chi Square Analysis

Crosstab: Gender * Received Final Grade

Gender	Received Final Grade		
	Yes	No	Total
Males	83	57	140
Females	134	101	235
Total	217	158	375

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.185(b)	1	.668
Likelihood Ratio	.185	1	.667
Linear-by-Linear Association	.184	1	.668
N of Valid Cases	375		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 58.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.022	.668
	Cramer's V	.022	.668
N of Valid Cases		375	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Ethnicity * Received Final Grade

Ethnicity	Received Final Grade		
	Yes	No	Total
White	134	95	229
Non-white	83	63	146
Total	217	158	375

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.101(b)	1	.750
Likelihood Ratio	.101	1	.750
Linear-by-Linear Association	.101	1	.750
N of Valid Cases	375		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 61.51.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.016	.750
	Cramer’s V	.016	.750
N of Valid Cases		375	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Enrollment Status * Received Final Grade

Enrollment Status	Received Final Grade		
	Yes	No	Total
Full-time	133	95	228
Part-time	83	60	143
Total	216	155	371

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.003(b)	1	.956
Likelihood Ratio	.003	1	.956
Linear-by-Linear Association	.003	1	.956
N of Valid Cases	371		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 59.74

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.003	.956
	Cramer's V	.003	.956
N of Valid Cases		371	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Marital Status * Received Final Grade

Marital Status	Received Final Grade		
	Yes	No	Total
Single	162	117	279
Non-single	55	39	94
Total	217	156	373

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.006(b)	1	.940
Likelihood Ratio	.006	1	.940
Linear-by-Linear Association	.006	1	.940
N of Valid Cases	373		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 39.31.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.004	.940
	Cramer’s V	.004	.940
N of Valid Cases		373	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Marital Status * Received Final Grade

Marital Status	Received Final Grade		
	Yes	No	Total
Married	39	28	67
Non-married	178	128	306
Total	217	156	373

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.000(b)	1	.995
Likelihood Ratio	.000	1	. 995
Linear-by-Linear Association	.000	1	. 995
N of Valid Cases	373		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 28.02.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.000	.955
	Cramer's V	.000	.955
N of Valid Cases		373	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Marital Status * Received Final Grade

Marital Status	Received Final Grade		
	Yes	No	Total
Divorced/Separated	16	11	27
Not Divorced/ Separated	201	145	346
Total	217	156	373

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.014(b)	1	.906
Likelihood Ratio	.014	1	.906
Linear-by-Linear Association	.014	1	.906
N of Valid Cases	373		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 11.29

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.006	.906
	Cramer's V	.006	.906
N of Valid Cases		373	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Developmental Math Preparation * Received Final Grade

Math Remediation	Received Final Grade		
	Yes	No	Total
Additional Math Remediation	99	66	165
No Additional Remediation	71	58	129
Total	170	124	294

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.731(b)	1	.393
Likelihood Ratio	.730	1	.393
Linear-by-Linear Association	.728	1	.393
N of Valid Cases	294		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 54.41

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.050	.393
	Cramer's V	.050	.393
N of Valid Cases		294	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Course (MA050/MA060) * Received Final Grade

Course	Received Final Grade		
	Yes	No	Total
MA050	70	42	112
MA060	147	117	264
Total	217	159	376

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	1.498 (b)	1	.221
Likelihood Ratio	1.509	1	.219
Linear-by-Linear Association	1.494	1	.222
N of Valid Cases	376		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 47.36.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.063	.221
	Cramer's V	.063	.221
N of Valid Cases		376	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Campus * Received Final Grade

Campus	Received Final Grade		
	Yes	No	Total
Andover	178	113	291
El Dorado	39	46	85
Total	217	159	376

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	6.298 (b)	1	.012
Likelihood Ratio	6.237	1	.013
Linear-by-Linear Association	6.282	1	.012
N of Valid Cases	376		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 35.94.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.129	.012
	Cramer's V	.129	.012
N of Valid Cases		376	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Class Time * Received Final Grade

Class Time	Received Final Grade		
	Yes	No	Total
Day	131	74	205
Evening	86	85	171
Total	217	159	376

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	7.076 (b)	1	.008
Likelihood Ratio	7.083	1	.008
Linear-by-Linear Association	7.057	1	.008
N of Valid Cases	376		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 72.31.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.137	.008
	Cramer’s V	.137	.008
N of Valid Cases		376	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Parent Education * Received Final Grade

Parent Education	Received Final Grade		
	Yes	No	Total
Continuing Generation	72	57	129
First Generation	126	95	221
Total	198	152	350

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.048 (b)	1	.827
Likelihood Ratio	. 048	1	.827
Linear-by-Linear Association	. 048	1	.827
N of Valid Cases	350		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 56.02.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.012	.827
	Cramer's V	.012	.827
N of Valid Cases		350	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Academic Preparation * Received Final Grade

Academic Preparation	Received Final Grade		
	Yes	No	Total
Needs Developmental Reading or Writing	30	14	44
Developmental Reading or Writing Not Needed	149	112	261
Total	179	126	305

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	1.911 (b)	1	.167
Likelihood Ratio	1.960	1	.162
Linear-by-Linear Association	1.905	1	.168
N of Valid Cases	305		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 18.18.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.079	.167
	Cramer's V	.079	.167
N of Valid Cases		305	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Academic Preparation * Received Final Grade

Academic Preparation	Received Final Grade		
	Yes	No	Total
Needs Developmental Reading and Writing	21	24	45
Developmental Math Only	151	98	249
Total	172	122	294

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	3.066 (b)	1	.080
Likelihood Ratio	3.023	1	.082
Linear-by-Linear Association	3.056	1	.080
N of Valid Cases	294		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 18.67.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.102	.080
	Cramer's V	.102	.080
N of Valid Cases		294	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Chi Square Analysis

Crosstab: Parenthood * Received Final Grade

Parenthood	Received Final Grade		
	Yes	No	Total
No Dependents	114	79	193
Dependents	80	58	138
Total	194	137	331

Chi Square Tests

	Value	df	Asymp. Sig. (2 sided)
Pearson Chi-Square	.040 (b)	1	.842
Likelihood Ratio	.040	1	.842
Linear-by-Linear Association	.040	1	.842
N of Valid Cases	331		

a) Computed only for a 2x2 table.
b) No cells have expected count less than 5. The minimum expected count is 57.12.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.011	.842
	Cramer's V	.011	.842
N of Valid Cases		331	

a) Not assuming the null hypothesis.
b) Using the asymptotic standard error assuming the null hypothesis.

Appendix I

Correlation Matrix: Demographic, Academic, and Attitudinal Variables Significantly Correlated with Self-regulated Learning

Variable	Pearson r	Sig.	Effect Size[a]
Perceived Usefulness of Math	**. 306**	**.001**	**Moderate**
Math Anxiety	**.197**	**.002**	**Small**
Gender	**.135**	**.027**	**Small**
Hours Worked	-.033	.320	
Age	**.253**	**.001**	**Small**
Parent Education	-.059	.201	
Dependents	**.159**	**.012**	**Small**
Marital Status (Unmarried)	**-.210**	**.001**	**Small**
Divorced/Separated	-.039	.292	
Black	-.063	.185	
Latino	-.064	.182	
Other Ethnicity	.005	.473	
Enrollment Status	.075	.145	
Math Preparation	.044	.266	
Academic Deficiencies (Two)	-.011	.437	
Academic Deficiencies (Three)	-.025	.362	

Note. N equals 203. Bold-faced type denotes significant relationship.
[a]Cohen, 1988.

Appendix J

Correlation Matrix of the Relationship Between Final Grades and Demographic, Academic, Attitudinal, and Self-regulatory Factors

Table 30

Correlation Matrix of the Relationship Between Final Grades and Demographic, Academic, Attitudinal, and Self-regulatory Factors

Variable	Pearson r	Sig.	Effect Size[a]
Gender	**.183**	**.024**	**Small**
Hours Worked	.075	.210	
Age	**.246**	**.002**	**Small**
Parent Education	.116	.107	
Dependents	.079	.200	
Marital Status (Unmarried)	-.109	.122	
Divorced/Separated	.024	.398	
Black	.023	.402	
Latino	.090	.167	
Other Ethnicity	.123	.094	
Enrollment Status	.104	.132	
Math Preparation	-.031	.369	
Academic Deficiencies (Two)	**-.171**	**.033**	**Small**
Academic Deficiencies (Three)	.008	.466	
Math Anxiety	**.218**	**.009**	**Small**
Perceived Usefulness of Math	**.206**	**.013**	**Small**
Self-regulated Learning (Comp)	**.417**	**.001**	**Moderate**

Note. N equals 117. Bold-faced type denotes significant relationship.

[a] Cohen, 1988.